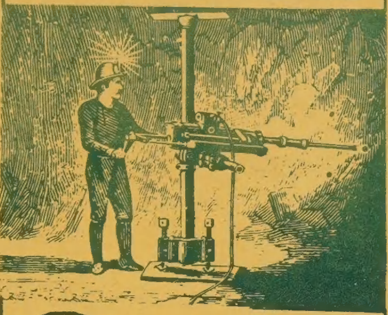

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Robert Mayo
CIVIL & MILITARY ENGINEER
LANCASTER • PENNSYLVANIA

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THE MOFFAT TUNNEL
of
COLORADO

AN EPIC OF EMPIRE

by

EDGAR CARLISLE McMECHEN
Author of
Robert W. Speer—A City Builder
Life of Governor Evans

AUTHORIZED BY RESOLUTION
of the
MOFFAT TUNNEL COMMISSION

IN TWO VOLUMES
VOLUME ONE

A limited issue of this De Luxe Edition has been printed from Kenntonian type by The Wahlgreen Publishing Company of Denver, Colorado.

George A. Levy, Director of Exploitation.

Each copy numbered, and signed by the author.

Edgar Carlisle McMechen

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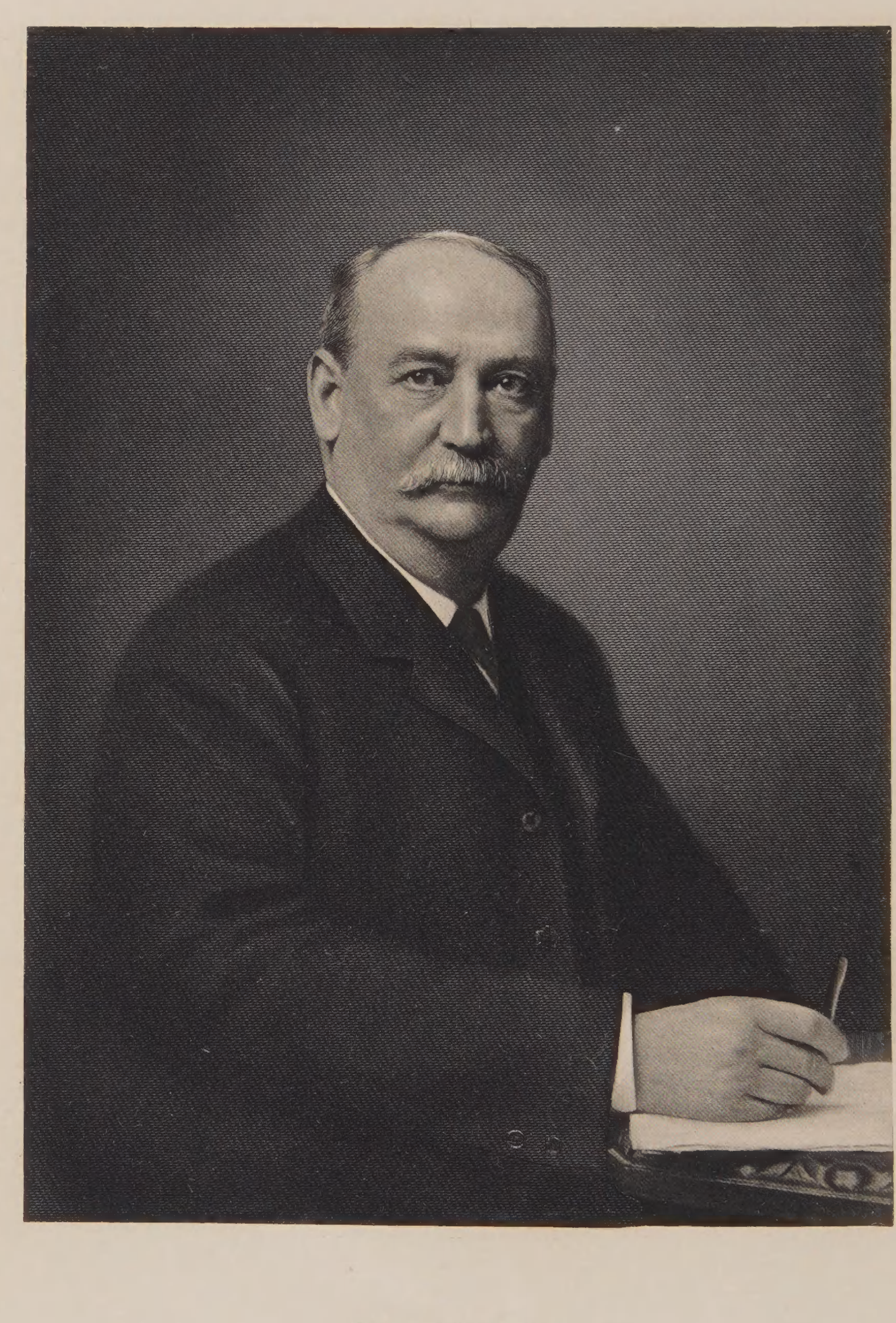

DAVID H. MOFFAT

INTRODUCTION

A MOUNTAIN of stone blocked the "path of empire." Commercial avenues were forced on unwilling detours far from a direct course across the continent, while beyond the wall a land of imperial proportions lay undeveloped. Then penetration of this barrier was undertaken, and tho great and unprecedented difficulties rose up to vex the engineer and discourage the builders, the determined persistence and ingenuity of resolute men have triumphed—the Moffat Tunnel is a reality.

A long series of obstacles and rebuffs blocked for years achievement of the ideal of a direct transcontinental railroad thru Colorado. From the days of our pioneers that ideal has enthralled the farseeing, beckoning empire-builders to measure their strength with the backbone of the continent. From the exploration by the old scout Bridger and the pioneer engineer Berthoud in 1861 (which revealed Berthoud Pass), search and survey have continued, while hopes of loyal Coloradoans rose or fell as promising roadway or baffling obstacle was in turn reported. The struggle was long and heroic and its length and vigor now but brighten the glory of the final accomplishment.

With discriminating judgment Mr. McMechen has selected the salient features necessary for a clear exposition of this achievement, and by clothing these with interesting detail and spirited incident has woven a story of compelling interest. It is a fascinating account of pioneering, the story of the persistence and achievement of an ideal. The elements of drama are inherent in the theme, the characters and situations are well drawn and the portrait of the leading man wins acclaim.

The historian will be pleased with the volume, for citation of sources and accuracy of statement meet the needs of scholar and student. Not less will be the appeal to the popular reader, for the narrative flows with a smoothness and interest characteristic of the best novel. Fortunate are we in having the epic-like story so ably told.

LeRoy R. Hafen, *Historian,*
State Historical Society of Colorado.

PREFACE

THERE is inherent within the human mind an incurable propensity to marvel over physical phenomena, to wonder at extraordinary material accomplishments of the race. In writing the story of the Moffat Tunnel this desideratum has repeatedly come to mind in connection with an incident related by a writer of the national parks service. At the foot of Yosemite Falls, this writer had encountered a woman who was amazed at the height of the cataract. She listened with apparent interest as he dramatically traced the action of water and ice, and estimated the ages since Merced River flowed at the level of the cataract's brink. Then she made this comment: "I've seen the tallest building in the world, and the longest railroad, and the greatest lake, and the highest monument, and the biggest department store, and now I see the highest waterfall. Just think of it."

In one sense we all are tourists. So let it be understood without further prelude that the Moffat Tunnel is the longest in the United States; that seven hundred fifty thousand cubic yards of rock, equivalent to sixteen hundred freight trains of forty cars each, were excavated to create this six and two-tenths miles bore; that two million, five hundred thousand pounds of dynamite were exploded to accomplish this result; that seven hundred miles of drill holes were drilled, and eight hundred thousand pounds of drill steel were used; that twenty-eight million kilowatt hours of electrical energy were expended to drive machinery and furnish light; that eleven million feet of board measure, equal to two thousand miles of one-by-twelve-inch plank were utilized to timber the tunnel; that approximately eighteen million dollars were expended.

Inevitable and interesting tho these details may be, the story of the Moffat Tunnel is based upon dynamic human qualities more worthy of wonder, more lasting in their impress upon the mind. We may measure the actual cost of the railroad and tunnel by the dollar sign, but how shall we measure the mental energy employed in their construction? By what gage shall we judge the sacrifices, the concentrated thought, the suffering in mind and spirit that brought these works to completion? How shall we estimate the great aspirations and dreams of David H. Moffat and his associates?

While I have interpreted the motives that actuated these men from an idyllic standpoint, this book was not written as a panegyric of individuals; rather was it intended to point out that the tunnel is a result of that noblest of human attributes—the instinct to build bridges for those who come tomorrow. It represents more than a private industrial enterprise; it is the will of thousands, the culmination of a communal vision that had its inception sixty years ago. Could we but take the time to trace their histories, the greatest inventions of the human race, the most stupendous public works, have been more important from an inspirational than from a material aspect. Viewed in this light the Moffat Tunnel becomes a thing to excite our deepest wonder.

To the officials of the Moffat Tunnel Commission and the Moffat Railroad, who have furnished valuable information; to state officials and officers of the State Historical Society, who have given access to historical documents, to certain faculty members of state educational institutions, to chamber of commerce secretaries, and to many individuals who have had personal knowledge of David H. Moffat and the Moffat Road, I render warm thanks for assistance and helpful criticism in the preparation of this work.

E. C. M.

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THE MOFFAT TUNNEL OF COLORADO

Part One

THE BARRIER

BIRDS-EYE DRAWING OF THE GREAT COLORADO RIVER BASIN

Showing Reservoir Sites, Irrigable Land and Comparative Relation of the Denver & Salt Lake and Denver & Rio Grande Western Railroads

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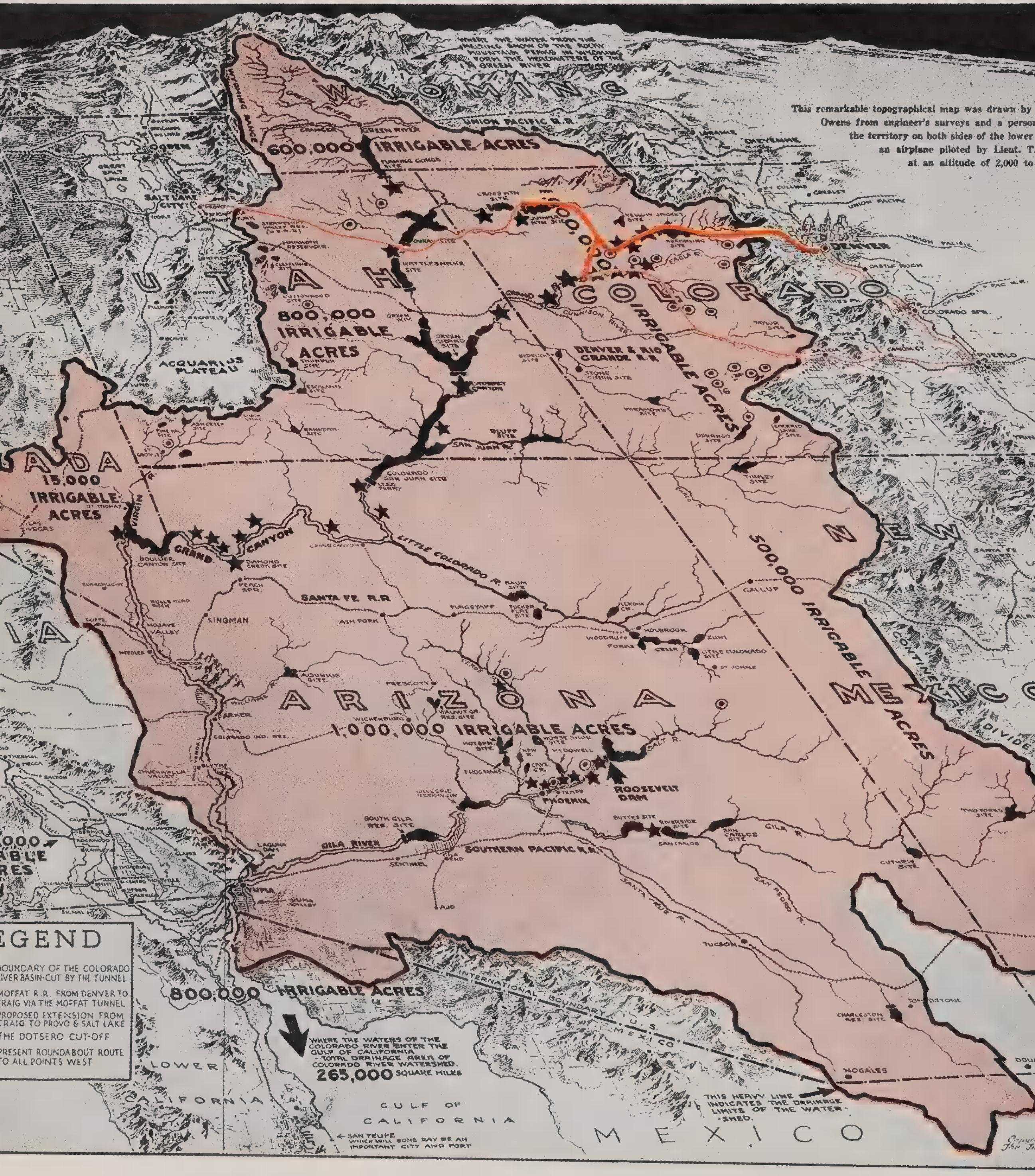

This remarkable topographical map was drawn by
Owens from engineer's surveys and a person
the territory on both sides of the lower
an airplane piloted by Lieut. T.
at an altitude of 2,000 to

EGEND
OUNDARY OF THE COLORADO
IVER BASIN-CUT BY THE TUNNEL
MOFFAT R.R. FROM DENVER TO
RAIG VIA THE MOFFAT TUNNEL
ROPOSED EXTENSION FROM
CRAIG TO PROVO & SALT LAKE
THE DOTSERO CUT-OFF
PRESENT ROUNDABOUT ROUTE
TO ALL POINTS WEST

WHERE THE WATERS OF THE COLORADO RIVER ENTER THE GULF OF CALIFORNIA
- TOTAL DRAINAGE AREA OF COLORADO RIVER WATERSHED.
265,000 SQUARE MILES

THIS HEAVY LINE INDICATES THE DRAINAGE LIMITS OF THE WATERSHED.

SAN FELIPE WHICH WILL SOME DAY BE AN IMPORTANT CITY AND PORT

"Were this great treasure house without strong national sovereignty, world powers would wage wars for possession of its coal, oil and minerals valuable in manufacturing industries. Wars have occurred ere this for similar resources vastly inferior in content."

PART ONE.

THE BARRIER

CHAPTER I.

EPIC CHARACTER OF THE MOFFAT TUNNEL—AN INDUSTRIAL NECESSITY—THE MOUNTAIN BARRIER—BACKGROUND OF THE COLORADO BUILDERS—THEIR HERITAGE OF COLONIAL IDEALS—THE RAILROAD AND DISCOVERY OF GOLD AS STIMULANTS OF IMAGINATION—EXPLORATORY WAGON ROADS—BERTHOUD PASS AND THE UNION PACIFIC—WINTER CONDITIONS ON THE HIGH PASSES—TERRITORIAL GROWTH HAMPERED BY UNCERTAIN STAGECOACH TRANSPORT—PACIFIC RAILROAD THE SOLE HOPE OF COLORADO PIONEERS.

HISTORIES, too frequently, are mere records of politics, wars and conquest. More often than not the stage chosen is the battlefield upon which warrior-statesmen play the leading roles, while the roar of conflict overwhelms the steady hum of commerce and industry. Yet there are dramas of peace, not so spectacular we grant, that ring with glory or sigh with bitter tragedy; there are soldiers of industry, who conquer reluctant nature rather than their fellow men; there are captains of finance, who exert a more lasting influence upon humanity than do the captains of war; there are epics of empire in which the cannonade of the air-drill, employed for beneficent ends, is more impressive than the machine gun's staccato roll.

The Panama Canal, the Simplon Tunnel, the Roosevelt Dam, the Eads Bridge, the Moffat Tunnel of Colorado are epics of this character.

The Moffat Tunnel, driven thru the Continental Divide, fifty miles west of the City of Denver, has been the cause of an industrial conflict that has lasted for a generation; that has wrecked fortunes; turned men old before their time and sent more than one prematurely to the grave. The story of the Tunnel is a modern tale of David and Goliath.

On the one side were ranged a comparatively obscure western millionaire and his friends; on the other the greatest railroad kings that America has known. Tho he did not live to enjoy the fruits of his victory the spirit of David H. Moffat triumphed. For more than four years now, a small army of men has been battling underground rivers and desperately stemming a tide of moving rock that has crushed steel wall plates with its incalculable weight. Courageous and resourceful tho these men have proven themselves, theirs has been the lesser task. They but opposed the silent, inert spirit of the mountain; while to Moffat, inspiration and genius of the Moffat Road, and to his lieutenants who carried on after their leader had died, must go credit for having successfully resisted the more sinister spirit of finance, always alert and constantly shifting its point of attack.

Within the last twenty-five years thousands of columns have been devoted by newspapers and magazines to exposition of the reasons for construction of the Moffat Tunnel, or of the Denver & Salt Lake Railway (The Moffat Road) which the Tunnel will make practicable as a transcontinental carrier. Wide interest has been aroused by this long-continued publicity, both because the Tunnel is one of the great engineering feats of the century and because, in a dim way, the public has been aware that a struggle of financial Titans has accompanied the stubborn progress of the project.

Reduced to its simplest terms the Moffat Tunnel may be interpreted by application of the first demonstration of Euclid, *i. e.*, a straight line is the shortest distance between two points. The Moffat Road, in conjunction with connecting railway lines on the east and on the west, approaches, as nearly as a railroad may, the shortest route between mid-Mississippi Valley and mid-Pacific Coast markets; and will place Denver and Salt Lake City, metropolises of the Rocky Mountain Region, upon their first transcontinental line. At the same time it will give direct thru routes between Chicago and San Diego, the Gulf of Mexico and Puget Sound. Of more immediate importance to the industrial development of the West, it will connect the drainage basins of the South Platte and Colorado Rivers, thus opening to commerce the largest and richest undeveloped land area in the world—the Upper Colorado River Basin. We do not except the unsettled wastes of Africa nor of South America, because they do not possess, save in extremely limited quantities, those natural resources that constitute the backbone of industry—coal and iron. North America has within its boundaries fifty-nine and three-tenths per cent of the coal resources of the world; Africa but one and two-tenths per cent, and South America only six-tenths of one per cent.[1] Colorado ranks first among all states of the American Union in bituminous coal resources occurring at a depth less than three thousand feet and, of the total tonnage of this classification within the state, eighty-two per cent lies in Northwestern Colorado, tributary to the Moffat Tunnel.[2] Were this great treasure house without strong national sovereignty world powers would wage wars for possession of its coal, oil and minerals valuable in manufacturing industries. Wars have occurred ere this for similar resources vastly inferior in content. There is more than a plausible reason for belief that the coal and iron deposits of central Europe were basicly involved in the World War.

The question arises, naturally, as to why the first transcontinental railroad failed to pre-empt the Colorado route. The Union Pacific, in fact, did prefer this line, as we shall show later, but was prevented from adopting it by two controlling reasons. First, there extends across the United States from north to south the great barrier of the Continental Divide, which traverses North America from Alaska to Panama. Between the uplands of Alaska and the volcanic peaks of Mexico a lower altitude prevails, but in the state of Colorado, for a distance of three hundred miles, is located the mid-crown of the barrier, varying in elevation from ten to fourteen thousand feet above sea-level. In Wyoming and in New Mexico are found the lowest passes. The unbroken core of the Divide is flanked in Colorado by many secondary ranges, outer boundaries of high mountain parks or plateaus, cut here and there by deep canons, thru which the rivers escape to the oceans. The width of this mountainous belt varies from seventy-five to one hundred fifty miles. The narrowest point in the Continental Divide is now pierced by the Moffat Tunnel, six and two-tenths miles long.

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[1] Twelfth International Geological Report, Toronto, 1913.
[2] Carpenter. *Colorado School of Mines Magazine.* Vol. XV, No. 10.

Surface passes within the state all impose circuitous alignment, heavy gradients and the consequent "tonnage lift," avoidance of which is the secret of successful railroading. It is readily apparent, therefore, that without the tunnel the Divide makes impractical transcontinental traffic within the state of Colorado. Secondly, when the first transcontinental railroads were built rapid progress and economic construction were determinative factors. Altho generally admitted at the time that the Colorado route offered the richest natural resources, the infant roads found extreme difficulty even in financing the lower passes and, as the emigrant trains had done, chose the lines of least resistance. Once established, the law of self-preservation arrayed these roads against all later rivals. Their tremendous resources and influence enabled them to control the sources of money.

The visible barrier to the Moffat Road was physical, the financial opposition intangible and unseen; but it was in the last mentioned obstruction that the promoters of road and tunnel encountered their highest Alps.

Considered solely from an investment standpoint, there is something inexplicable in the grim determination of Moffat and his associates to complete their project at any cost. Indeed, a satisfactory explanation does not lie in this direction. As a general rule all pioneer railroads of the country were financial failures for those who initiated them. One of Moffat's lieutenants has made the remark that he would not wish to have his business judgment appraised by his actions in connection with the railroad, as he had been constantly aware that there existed little chance to recover his investment during his lifetime. Moffat, already familiar with the difficulties of mountain railroad construction, was advised by a practical railroad man not to construct the Moffat Road because of the tremendous expense that would be involved.[3]

"I intend to build this road," he replied, "because I want to develop Colorado—and you are going to build it for me."

The reply clearly reveals the underlying purpose of those who launched the enterprise. Primarily, they sought the development of empire. Newly discovered lands, teeming with undeveloped natural resources, inevitably breed this constructive spirit in the pioneer inhabitants, and produce the type of men necessary for accomplishment. Many instances might be cited to support the truism; the most familiar to present day readers, Cecil Rhodes and the Capetown-to-Cairo Railroad. But it is unnecessary to search for further illustration beyond the immediate region that has produced a General William J. Palmer, a Governor John Evans, a David H. Moffat, a Brigham Young. The development of these characters was partially the result of environment, but, in a broader sense, it was due to the age from which they drew their inspirations. Theirs was the heritage of the most romantic and adventurous period in American history, beginning more than one hundred years ago when Napoleon signed away a potential empire greater than all his conquests; a fortunate act for the territory affected, because it permitted the development of a new world during its formative period by a homogenous people schooled in pioneer hardships and endowed with the rugged virtues of young nations.

The Louisiana Purchase, containing more than one million square miles of uncharted wilderness, appealed to the infant colonies as a great national adventure. The heads of the people still were in the clouds of new-won liberty, and the acquisition fitted well into their vision of vast domain for a free humanity. There followed in America a rebirth of that spirit of discovery and adventure engendered among the maritime nations of Europe by the voyage of Columbus. The country was thrilled by dreams of what might lie in store beyond the Mississippi. Soldier-explorers were sent west by the government

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[3] From an interview with A. C. Ridgway, first General Manager of the Moffat Road, originally incorporated as the Denver, Northwestern & Pacific.

—Captains Meriwether Lewis and William Clark, Lieutenant Zebulon M. Pike and Major Stephen H. Long—who gave a somewhat gloomy and forbidding account of the new land. The Great American Desert that long ago passed among the interesting fictions of the frontier, was pictured as a sun-burned desolation upon which civilized communities could not exist. In the light of these reports the Rocky Mountains towered to unscalable altitudes[4] where arctic conditions made them uninhabitable during the winter. So limited was knowledge of the country that Pike even conceived a transcontinental waterway, with a land portage of two hundred miles, that would seem from his description to be the route of the Denver & Rio Grande Western Railroad over Tennessee Pass.[5]

While these accounts served to lower the public temperature a few degrees, the plenitude of wild life, especially of fur-bearing animals, that had been noted by the explorers, attracted to the wilderness a class of adventurers as hardy as the indigenous Indian. The fur trappers and traders who penetrated the Rocky Mountains after Long's Expedition in 1820, familiarized themselves with the region as few since have done; yet they were the outriders of civilization and, because of their isolated habits, full benefit of their information was not felt until the advancing tide of emigration utilized them as guides.

There was at work, however, a leaven that, with the discovery of gold, was to sweep away the last American frontier. In this romantic period the world gave birth to modern transportation. The steam engine was conceived in the human imagination and, with its new-found iron lungs, civilization soon was to pant its triumphant course across rivers and deserts and mountains, accomplishing in one generation a conquest of nature that without it would have required the passage of centuries. Within the span of a man's life there occurred the most stupendous colonization the world has ever seen.

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[4] Pike estimated the Highest Peak (Pikes) to be 18,581 feet in elevation and wrote: "I believe no human being could have ascended the summit." *Pike's Explorations.* Lawrence Ed. 208.

[5] "By route of the Arkansas and Rio Colorado of California I am confident in asserting (if my information be correct) there can be established the best communication on this side of the Isthmus of Darien, between the Atlantic and Pacific oceans; as, admitting the most, the land carriage would not be more than two hundred miles." Idem. 209.

There was needed but a spark to launch the national adventure and this was furnished by the discovery of gold. The Mormon migration in 1847, followed by the traverse of the California Argonauts two years later, definitely established the Overland Trail thru Wyoming. There then existed two great routes of prairie commerce, the new line and the Santa Fe Trail, which determined, respectively and in a general way, the subsequent routes of the Union Pacific and the Atchison, Topeka & Santa Fe railroads.[6]

While the commerce of the prairies reached great proportions before it had become a certainty that a Pacific railroad would be constructed,[7] it soon became apparent to the States that wagon-freight alone never could weld the nation into a homogeneous whole; that the barrier of the Divide made transcontinental traffic on a grand scale practically impossible by beast of burden. This realization had made the Pacific railroad a topic of absorbing interest in Congress and, by the time that General Fremont's father-in-law, Senator Thomas H. Benton of Missouri, introduced his bill in 1850 for a central railroad route it had become only a matter of a few years when the government would take steps to prevent the growth of two nations within United States territory. The transcontinental railroad was believed by the most advanced thinkers to be a military necessity.

The army appropriation bill, which passed Congress March 1, 1853, authorized government surveys to determine the most feasible route, and Secretary of War Jefferson Davis dispatched four parties, none of which followed the Overland Trail. The possibilities of this route were comparatively well known and the apparent object of the new surveys was to locate, if possible, a better line. Of these surveys the only one to pass thru Colorado was the ill-fated expedition of Captain J. W. Gunnison, which left West Port June 23, 1853, followed the Arkansas River to the Huerfano, ascended this, crossed Sangre de Cristo Pass, San Luis Valley and Cochetopa Pass.[8]

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[6] In his chapter on "Transportation," *History of Colorado*, Vol. II, published by authority of the Colorado State Historical and Natural History Society, Arthur Ridgway has the following to say as to the influence upon rail transportation exercised by these trails: "Most significant is the fact as having the controlling influence on the development of transportation in Colorado that, at the southeast corner, the one of these famous 'trails' had detoured to the south and the other to the north, respectively, so as to leave Colorado soil practically untouched."

[7] By 1843 merchandise tonnage on the Santa Fe Trail had reached 450,000 tons and employed 230 wagons and 350 men; in 1850 on this trail 500 wagons and 5,000 animals were in service. In 1858 Majors Russell and Waddell had 3,500 wagons, 40,000 oxen, 1,000 men and 1,000 mules in operation between the Missouri River and Denver. Idem. 793.

Ere this the growing insistence of California for postal service involved the postmaster general of the United States. A service, not wholly satisfactory in character, had been established between Independence and Salt Lake City in 1850, and between Salt Lake and California in 1851.[9] This continued, with variations in schedule and operating companies, as the sole overland mail route until advocates of the southern railroad line succeeded in having inaugurated in 1858 the Butterfield Overland Mail between St. Louis and San Francisco. Because of a long detour thru what now constitutes southern New Mexico and Arizona it was popularly known as the "ox-bow route."[10] There is some probability that this effort eventually would have succeeded, because of the influence of Southern senators, had not discovery of gold in the Pikes Peak region in the summer of the same year given proponents of the Central route renewed confidence. Their efforts were redoubled and the Denver traffic began to justify their demands. The first stagecoach of the Pikes Peak & Leavenworth Express arrived in Denver May 7, 1859, and, this same month, its proprietors, Jones, Russell & Company, purchased the mail contract between Missouri River and Salt Lake from Hockaday & Liggett.[11] The following year the Kansas legislature granted a charter to the Central Overland California & Pikes Peak Express, which absorbed the pioneer line and soon afterward acquired from George Chorpenning the contract for mail service between Salt Lake and Placerville, California. In order to establish the supremacy of the Central Route and, upon promise of a government subsidy, President W. H. Russell of the new company established in the spring of 1860 one of the most remarkable institutions used in colonization of the Far West—the Pony Express. The total time of its operation was nineteen months, during which period the promoters lost a net amount of two hundred thousand dollars.[12] Congress failed to grant the expected subsidy, but the Pony Express succeeded admirably in demonstrating the practicability of the Central Route, carrying the mail on schedules that, even in winter months, generally did not exceed sixteen days. Completion of the telegraph line ended its usefulness.[13] Frequent stations were established; tough, fast and wiry ponies purchased, young and daring riders employed, and the enterprise executed with an elan that captured the nation's fancy. Many famous writers have perpetuated this dramatic chapter of the old West. In the entire history of the United States Mail the only rival to the Pony Express in popular imagination has been the transcontinental air mail.

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[8] Idem. 810.
[9] Hafen. *The Overland Mail.* 57-63.
[10] Idem. 94.
[11] Idem. 150.
[12] Idem. 190. The Pony Express began operations April 3, 1860.

The guns of Fort Sumter placed the quietus upon the southern route and, on March 2, 1861, Congress passed the Daily Overland Mail bill for a route through the central region. Under its provisions the Central Overland California & Pikes Peak Express was authorized to transport the mail east of Salt Lake City, while the Butterfield Overland Mail was uprooted from its southern location and given the route west to the Coast.

Under this arrangement Russell and Bela M. Hughes, president of the reorganized C. O. C. & P. P. Express, visited Denver in the spring of 1861 to plan a mail route over the old Cherokee Trail, which followed the foothills from Pueblo to Fort Laramie. They found the settlements in a ferment over the possibility of securing the Pacific railroad and were readily converted to a local scheme that had as its object the location of a feasible pass directly west of Denver. A party of discovery was organized by local residents for this purpose. It consisted of ten men under command of Lieutenant Edward L. Berthoud.[14] James Bridger, famous frontiersman, had been brought to Denver by the express company to help locate the Cherokee Trail route, but was sent with Berthoud instead.[15] On May 15 the party found the pass for which it sought, situated at the head of

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[13] Idem. 187. The telegraph line was completed October 24, 1861.

[14] Lieutenant Berthoud, the engineer who built the Colorado Central Railroad, was a native of Switzerland. His parents brought him to New York when he was two years old—in 1830. He served as engineer on the Panama Railway in 1851, and drove to Golden, Colorado Territory, in 1860, where he long remained as a resident. *Steamboat Pilot.* December 26, 1923.

[15] Hafen. *Colorado Magazine.* Vol. III, No. 1.

Clear Creek in the heart of the gold region. Altho never crossed by a railroad, Berthoud Pass has become known in this day as one of the picturesque transcontinental automobile passes of the nation. The discovery caused intense excitement in the mining districts, for the first reports were more sanguine than later investigation justified.

Berthoud and Bridger were dispatched with a reconnaissance party to survey a wagon road to Salt Lake City, to be operated by United States mail coaches. They left Denver July 6, 1861,[16] crossed Berthoud Pass from Empire to Hot Sulphur Springs in Middle Park; thence traveled northwestward by Gore Pass[17] to the headwaters of the Yampah (Bear) River; down this stream to near the mouth of the Little Snake; southwest to White River; down the White to Green River; up the Uintah and across the Sawatch Range to Provo and Salt Lake.[18] Berthoud wrote from Salt Lake in enthusiastic vein, declaring the route feasible either for wagon or railroad. He gave the total distance for a wagon road as four hundred twenty-six and five-eighths miles, and estimated the cost at one hundred thousand dollars.[19] In the meantime, since the United States Mail could not wait upon discovery expeditions, the original projection over the Cherokee Trail had been put into effect.

The Berthoud report aroused in Denver and the adjacent mining camps of Clear Creek and Gilpin counties high hopes that the Union Pacific would adopt the pass. To the astonishment of the public, the territorial legislature at its first session in 1861 incorporated the Colorado & Pacific Wagon, Telegraph and Railroad Company, giving it a charter to build over Berthoud. This company was a private corporation capitalized for five hundred thousand dollars. The act was approved by Governor William Gilpin, November 6, 1861. Public opinion had accepted Berthoud Pass as common property to be reserved for the benefit of the Union Pacific, and in thus filing upon

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[16] Idem.

[17] The Gore Range and this pass both were named after Sir George Gore, a wealthy English sportsman, who hunted in the Rockies from 1854-56. He cut a road across this range, taking six wagons, twenty-one carts, one hundred twelve horses, and a retinue of forty men into the Bear River country. Alter. *James Bridger*, 268; also see Hall, *History of Colorado*.

[18] With the exception of Berthoud Pass, this route closely approximates the line and surveys of the Moffat Railroad, and nearly all other surveys for railroads to Salt Lake City from Denver.

[19] Berthoud's letter from Salt Lake in the *Rocky Mountain News*, August 19, 1861.

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it the local incorporators brought upon their heads severe censure. Charges were made that the bill was nothing more than an extortion measure.[20]

Soon after the appointment of Governor John Evans of Chicago as second territorial governor of Colorado, a more thoro examination of the pass was made by the new governor, William N. Byers of the *Rocky Mountain News,* and Francis M. Case, a former engineer on the Pacific Survey. During the month of June, 1862, Case surveyed a line to the summit from the Clear Creek side. His report placed a damper upon popular enthusiasm, for Case declared the route too steep to suit the maximum grade allowed the Union Pacific—one hundred sixteen feet to the mile—and added that a tunnel would be necessary, both because of the altitude, eleven thousand four hundred ninety-five feet, and the prevalence of snow there thruout the summer.[21] While Case was wrong in the latter two assumptions, his main findings have been justified by all later surveys.

The failure of the Central Overland California Pikes Peak Express about this time practically ended the project to carry United States mail over Berthoud Pass,[22] as it removed from the affairs of the company William H. Russell, its chief advocate within the organization. Russell did not lose interest in the plan. This same year, with several other men, he incorporated the Clear Creek & Hot Sulphur Springs Wagon Road, to be built over Vasquez Pass, named after Louis Vasquez, an early fur trapper.[23] Two years later Russell became one of the incorporators of the Denver & Pacific Wagon Road Company.[24] Associated with him in the latter venture was W. A. H. Loveland, one of the most able and indefatigable of early Colorado railroad builders. Desultory work was done on this route for two years.

The territorial legislature annulled the charter of the Colorado & Pacific Wagon, Telegraph & Railroad Company February 10, 1865, and on the same day chartered the Overland Wagon Road Company, granting to it the choice of Berthoud or Boulder passes for a route to Salt Lake and the Coast. Ben Holladay, purchaser of the C. O. C. & P. P. Express, and Bela M. Hughes were the incorporators. Under the direction of Hughes, a survey was made from Salt Lake to Denver, the party leaving Salt Lake June 3, 1865, and following the Berthoud-Bridger route. Four months were consumed on this trip. Upon arrival at the Continental Divide with Colonel Johns of the California Volunteers, who had accompanied the party with a military detachment, one hundred fifty men and twenty-two wagons were taken across Boulder Pass. These were the first wheeled vehicles ever to cross Boulder, or Rollins Pass, where the rails of the standard gage Moffat Road made the crossing forty years later. Hughes announced that Berthoud would be used for the wagon road, and the following year the Overland Company was given its territorial charter. The project, however, was never realized. When the Overland Company elected to use Berthoud, the same legislature that confirmed its right-of-way granted to J. Q. A. Rollins,[25] on February 6, 1866, a charter for the Middle Park & South Boulder Wagon Road to be constructed over Boulder Pass.[26] Rollins, in 1865, guided to Utah one hundred Mormons with their train of thirty-nine teams.[27] According to old settlers on the South Boulder, this train was taken across Boulder Pass, undergoing terrible hardships. In making the climb, men, women and children carried part of the wagon contents upon their backs to lighten the load, and sang hymns to cheer onward the weary. Rollins' road, which was forty miles long, was not completed until 1873,[28] but the pass, after he had received the territorial grant, became known as Rollins Pass. In places the road touched the Ute Trail that, before the era of the white man, had been a hunting and war path for mountain Utes and plains Indians. This trail passed Echo Lake at the base of James Peak, climbed high above the East Portal of the Moffat Tunnel as now constructed, followed the summit of the Divide for about two miles and dropped down Ranch Creek to Middle Park.[29]

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[20] *Rocky Mountain News,* October 30, 1861; April 23, 1862.
[21] Idem. July 24, 1862.
[22] Hafen. *The Overland Mail.* 227.
[23] Territorial Session Laws of Colorado, 1862.
[24] Idem. 1865.

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[25] John Quincy Adams Rollins was among the most interesting of Colorado pioneers. Born in Gilmantown, N. H., June 16, 1816, he made a fortune in lumbering and cattle-dealing on the Mississippi before driving to Denver in 1860 with a nineteen-team ox-train. He went to Gold Dirt, Boulder County, where he engaged extensively in mining. In this he was successful, both in Boulder and at Buckskin Joe in Park County. He amassed several fortunes, but invested in several unfortunate enterprises. Of these a salt works in South Park, where he lost $60,000, and a partnership in the stageline of Butterfield & Rollins, were the most disastrous. His partner in the latter venture was Col. D. A. Butterfield of Overland Mail fame. Bixby, *History of Clear Creek and Boulder Counties*, 476. Fossett, *Colorado*, 345.

[26] *Territorial Session Laws of Colorado*, 1866.

[27] Bixby, *op. cit.*, 474.

[28] Idem. 474.

The first wagon road over the Divide at the head of Clear Creek was that of the Colorado & California Wagon Road Company, chartered by the legislature in 1867. John S. Jones, who was given the right-of-way over Jones Pass, several miles south of Berthoud, actually constructed the road and is said to have taken wagons across, altho there seems to be doubt upon this point. Except for stock movement it was little used and gradually relapsed to a state of impassability. The builder, who owned a ranch on the Grand (Colorado) River, had been a member of Jones, Russell & Company, founders of the Leavenworth & Pikes Peak Express, and was a fit partner to the "Napoleon of the West," as Russell has been called. Too much cannot be said in praise of these notable pathfinders of the prairies, whom no danger could deter and no hardship daunt. Command of a pioneer freight or stage line during the settlement of the frontier was no task for a weakling. Indian raids, attacks by desperadoes, seas of mud in the springtime, death-dealing storms in winter, were but a few of the hazards. It required grim courage, perseverance, executive ability of the highest degree, to maintain a line of operations in the face of numberless adversities; as well as a genius for command to rule the half-lawless employes who manned the route. Russell was a man of daring and initiative. Who but one of initiative and imaginative power could have carried out the spectacular gamble of the Pony Express, or could have thrown his influence toward an experimental eleven-thousand-foot passage of the Continental Divide as against an established trail, having knowledge of what a high mountain pass is in winter?

That Jones was no less courageous and, perhaps, even more tenacious than Russell may be inferred by his feat in building the Jones Pass Road. Even more dramatic was a mid-winter trip in 1865-66 across Breckenridge Pass from South Park to Blue River when he took seven loaded freight wagons thru snow-drifts twenty-five feet deep with the thermometer ranging from zero to twenty degrees below. This terrible experience so well describes snow-hazards and arctic conditions upon the high passes of the Rockies in winter—the basic reasons for construction of the Moffat Tunnel—that Hollister's account of the trip in his *Mines of Colorado* is quoted as the best delineation we could give.

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[29] The Indians used Rollins Pass because of its easy approach, freedom from timber and plentiful water supply. While they possessed no wagons, they were encumbered in crossing high mountains or in passing thru heavy timber, due to their habit of tying their tepee poles to the sides of ponies, the ends dragging upon the ground. Midway between the ponies' tails and the ground, household belongings were lashed to the poles. The Utes used the Pass when going to the plains for buffalo hides and meat; the Arapahoes and Cheyennes when seeking tepee poles, made from the lodgepole pine, which grows only above an elevation of nine thousand feet. Both sides utilized the route when on the war path, and this led the Utes to erect stone fortifications on the summit, built in zig-zag formation. *Municipal Facts*, Vol. VI, Nos. 8 and 9.

"From the town of Hamilton goes the route north-northwest through what is called Breckenridge Pass, to the mines on the Blue, on the Pacific Slope. It was through this pass that John S. Jones of Empire took a train of wagons loaded with twenty thousand pounds of freight in the dead of winter of 1865-66. He was aiming to open a ranch on Bear River, west of Middle Park, but owing to the loss of his stock, was obliged to locate temporarily on the Grand in Middle Park. Perhaps a sketch of his trip would convey the best idea of the climate, fall of snow, etc., of this range of the Rocky Mountains of anything we could give. The train started from Denver December 8, 1865, and on the fifteenth had arrived at Slaght's Ranch on the north branch of the South Platte, the mercury having ranged since the twelfth from nine degrees to twenty-two degrees below zero. On the seventeenth they were at Hamilton, mercury at zero, deep snow in the pass eight miles above Hamilton, seven men constantly shoveling snow. Of the last eight days, on the eighteenth the mercury stood at sixteen degrees above zero, on the ninteenth eight degrees below, on the twentieth at zero, twenty-first ditto, twenty-second ten degrees below, twenty-third and fourth about at zero, twenty-fifth twenty degrees below. The snow averaged thirty inches in depth, while some of the drifts were twenty-five feet deep and three hundred feet long. Hay was brought from Hamilton and there was little difficulty in keeping the track open. The next five days, the mercury standing at about zero, were consumed in getting the train one-half mile down the summit on the western slope. On the last day of the year the mercury marked eighteen degrees below zero and the men were completely discouraged. A huge slide was made, the camp and garrison equippage put aboard (the wagons and freight left to be brought on afterwards) and at 10 o'clock it started out, Jones and one other man having broken and shoveled some sort of a track. Two and one-half miles were made before stopping, the last one in thick timber where the snow was not drifted. Next day the camp reached Breckenridge, eight miles from the summit, through two feet of snow. That night the mercury sank to twenty degrees below zero. The extra stock was sent forward fifteen miles where the snow was less than a foot deep and the sunny sides of the hills were bare, sleds were made for the mules, and by the twenty-seventh of January the wagons and freight had been brought from the summit down to Breckenridge. It had been snowing almost continuously since New Year's. On the twenty-first and twenty-second a warm rain fell, settling the snow about a foot. The loose stock had been driven five or six miles ahead and arrangements made for someone to come up from the Park and get them. But from a misunderstanding no one came, and there being a stiff crust on the snow, rendering it difficult to get around, they stood still and starved and froze to death. There was no wagon road down the Blue, so the freight was packed on mules and ponies, which proceeded on the ice to the Grand. The sequel of the expedition is of no particular interest in this connection, but is soon told. Jones opened a ranch low down on the Grand in Middle Park, but he had not time to fence or watch it, and so, although the wild flag grass and grain grow there so rank as to almost hide a horse, he got no crop."

Experiences such as these had demonstrated that wagon traffic would not suffice for further development of Colorado Territory. Aside from gold mining and its supplemental activities there was no industry to support a large population. Heroic efforts were made to open new districts by wagon road, as evidenced by the fact that between 1860 and 1870 forty-three territorial acts were passed authorizing toll roads.[30] An Indian attack on a wagon-train, a spring flood or prairie blizzard were sufficient to interrupt communications, with a resultant increase in the cost of supplies. Added to this the expense of mining was rising in a steady ratio, for surface mines in the Clear Creek and Gilpin districts had been exhausted within a few years after discovery. As the lode mines grew deeper and filled with water, the use of steam was required in hoisting. Timber, practically the only fuel, was being depleted at a rate that would soon make it prohibitive. In the early sixties the hills north of Clear Creek were covered with a heavy growth of Engelmann spruce. Today, nearly seventy years later, a young growth is just reappearing to cover the barren and dump-scarred mountains. The ores became more difficult of treatment as the shafts descended, and expensive machinery became a necessity. Two competent writers upon mining conditions of the day have declared that the best stamp mills saved only twenty-five per cent of the gold mined.[31] Hollister wrote: "The construction of a railway along the Platte Route during the summer of 1866 at the rate of twenty miles a week, has reduced freights to Colorado fifty per cent of their previous average."

Under such conditions and, with such a historical background as described in the foregoing pages, we may partially understand the anxiety with which the pioneers watched the gradual advance of the Union Pacific across the prairies. The railroad was their star of hope. To the settlers a northern route meant destruction of all they had builded so painfully, a return to the savage domain of the Indian. Such might well have been the case had not the railroad been constructed. The mountains of Colorado and of every far-western state are dotted with "ghost camps," sad memorials of the golden era of mining, where deer feed on the long grass in the deserted streets. The pioneer leaders, with prophetic eye, envisioned such a possible fate for Denver and its outlying fringe of mining towns.

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[30] Ridgway, *op. cit.*, 803.

[31] "The moment railroad facilities from the mountains to the States become a fact, instead of an anticipated event of the future, there will be a marvelous stimulant given to the mining industry of the country, making fortunes where now they are wasted, because permitting of a different treatment of ores, by which all the useful metals may be saved; whereas now, the gold only is sought, and even but twenty-five per cent of that is saved." *Communication Relative to the Location of the U. P. R. R. Across the Rocky Mountains Through Colorado Territory*, 1867. By A. N. Rogers. Hollister placed the same estimate upon the percentage of gold saved, *Mines of Colorado*, 139.

This was the background of the Colorado pioneers that filled them with the stern determination never to relinquish the fight for a transcontinental railroad. This was the heritage of David Halliday Moffat.

CHAPTER II.

THE PIKES PEAK GOLD REGION IN EIGHTEEN SIXTY—ARRIVAL OF DAVID H. MOFFAT—HIS CHARACTER AND ORIGIN—IMPRESSIONS OF PIONEER DENVER—MOFFAT'S MARRIAGE—INDUSTRIAL SITUATION—GENERAL DODGE'S SURVEYS—CHEYENNE ROUTE CHOSEN BY UNION PACIFIC—DISAPPOINTMENT OF MINING TOWNS—ROGER'S PLAN TO TUNNEL THE DIVIDE—ORGANIZATION AND CONSTRUCTION OF DENVER PACIFIC—ERA OF RAILROAD DEVELOPMENT—THE RIO GRANDE AND PALMER—MOFFAT SUCCEEDS TO THE INDUSTRIAL THRONE IN COLORADO.

PRAIRIES and foothills of the Pikes Peak region in the year 1860 glided imperceptibly from mild winter into delightful and balmy spring. There had been little snow and, in early March, native grasses on sunny slopes and favored hillsides turned a lucent green. Less reassuring to white settlers on isolated ranches, and even in puny frontier towns, was a smoke haze lasting for weeks, that drifted in from the plains and dimmed the clear light of the sun; a sign that the children of the soil, stirred by desire for fresh meat and by the energizing warmth, were preparing the path for the buffalo herds. Somewhere on the great blind prairies lodges of Arapahoes and Cheyennes, of Sioux and Kiowas, were firing the dead grass that the new growth might be more abundant. Shadowy, elusive, untamed and untamable as wachunka monet, the medicine wolf, these Indians were constant menaces to the peace and prosperity of the pioneers.

The mountains still were snowbound, but here, too, evidences of spring were unmistakable. The first express coach to arrive at the mines of Mountain City created a sensation.[32] Plumes of white steam from the hoisting engines floated in the frosty air. Teamsters were arriving constantly with loads of logs for mine timbers and rude cabins. For a few hours each day, while the sun was high, handrockers rattled and arrastres groaned in Gregory and Russell gulches. Forty feet of a gold claim in Russell Gulch sold for four thousand dollars, forerunner of fabulous prices to follow.[33] A man from Nevada Gulch created a day's sensation when he brought in a fine nugget, weighing over one hundred pennyweights.[34] On the morning of March first the residents of Missouri City arose to find a certain disreputable townsman decorating a neighborly pine. The night before some two hundred men from the rival town of Mountain City had paid an unceremonious but earnest visit and had left this grewsome calling card. Missouri City had not intended to honor this departed citizen with public office, but it resented the violation of its sovereignty.[35] Yes, spring had come in the mountains, and with it had been revived the age-long quest for gold.

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[32] *Weekly News*, March 7, 1860.

Denver City, supply base for the mining camps, shook off its winter lethargy. Its twelve hundred inhabitants, nearly all of the masculine gender, found less time to discuss settlement politics. The burning question of the last few months, whether Congress would recognize the extra-legal territory of Jefferson, organized the previous winter,[36] now seemed unimportant in comparison to the latest gold lode discoveries. Mule teams left for Mountain City, Hamilton and the Boulder diggings with more regularity. The new town of Highland, across the river from Denver and Auraria, was growing like a mushroom. Buildings arose as by magic along the banks of the South Platte and Cherry Creek. All day lumber wagons creaked thru the streets, and the sound of hammer and saw was continuous from morning until night.

Each day a few mule teams from the States drove in, but these, in most instances brought only traders with stocks of merchandise. It was the vanguard of the ox-trains, loaded with household goods and gold hunters, who were to come during the succeeding months at the rate of five thousand a week.[37] The *News* began to print extracts from Mississippi Valley exchanges that told of the slow-moving host as it passed thru small towns in Ohio, Illinois, Iowa or Nebraska.

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[33] Idem. March 21, 1860.
[34] Idem. March 7, 1860.
[35] Idem.
[36] Organized December 3, 1859. Charter of the City and County of Denver, 1916.
[37] Goodykoontz on "The Settlement of Colorado." *History of Colorado*, 436.

Some of these tenderly bid adieu to fellow townsmen and wished them success; some were jocular; some frankly pitied the deluded ones and predicted much sorrow and tribulation ere they should reach "the other side of Jordan." The numberless covered wagons converged on the starting points of the Missouri, refitted, swung ponderously into line on the Overland Trail. At times the column would stretch in unbroken formation for miles across the rolling prairies. Great clouds of dust drifted from the plodding feet of the oxen as they swayed heavily from side to side. Along the route were evidences of that wild flight back to civilization made the preceding year when thousands of disgruntled ones fled in dismay from the granite peaks that would not yield their own. Broken wagons, scattered equipment, bleaching bones of beast and man, were the grim markers of the Trail.

The late arrival column of the *Weekly News* lengthened with such items as these:

> John H. Gregory & Co. arrived on the 4th inst.—17 men, 1 woman, 5 wagons, 18 horses, mules and oxen—42 days from St. Joseph via Platte Route. Brought one quartz mill and two wagon loads of butter and building hardware. Mr. Gregory is looking well after his eastern visit. He has left for the mountains to resume business in his old mines.[38]
>
> On Saturday, 17th, D. H. Moffat and W. M. Keith, twenty-nine days from Omaha, three men and two teams, freighted with books and stationery, to establish a store in this city.[39]

The young man who drove his mule teams into the little frontier town at the base of the Rocky Mountains that St. Patrick's Day in 1860, at first glance must have given no impression that some day he was to become the leading citizen of a great commonwealth. He was a smooth-faced youth of twenty years, very tall and exceedingly thin. He looked as tho he might be blown away by the March wind that hurtled across the open prairies, for he weighed but one hundred pounds. Yet men liked him upon sight. He was frank and engaging, more than willing to accommodate, and blessed, moreover, with a limitless capacity for friendship.[40] Neither great wealth nor greater worries ever were to affect that admirable quality.

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[38] *Rocky Mountain News*, March 7, 1860. Gregory discovered the first gold lode in Colorado.

[39] Idem. March 21, 1860. There is a discrepancy in the date of Moffat's arrival in Denver. Records of the Pioneers' Society, presumably based upon personal interview, place this date as March 8, 1860. We accept the *News* date because of the detail related, and because Byers had known Moffat in Omaha, and surely would have mentioned his presence had he been in Denver earlier.

Dave Moffat was not wholly unprepared, as many emigrants were, to assimilate frontier conditions. Born in Washingtonville, Orange County, New York, July 22, 1839, of Scotch-Irish ancestry,[41] he had left his father's farm when twelve years old and, with only the advantages of a country school education, had gone to New York City to make his own way in the world. There he had become messenger in the New York Exchange Bank, rising by 1855 to the position of assistant teller. Samuel Moffat, an elder brother then living in Des Moines, Iowa, persuaded David that the West afforded opportunities for young men. The latter became teller in the banking house of A. J. Stevens & Co., Des Moines, and showed such aptitude that at seventeen he was appointed cashier of the Bank of Nebraska, owned by B. F. Allen of Omaha.[42] From the first he displayed an ambition to make himself financially independent. Towns along the Missouri were booming in anticipation of the Pacific Railway location. Each hoped that the lightning would strike it, and the value of property rose and fell as that hope flowed and ebbed. Moffat is reported to have speculated in Omaha lots to such good purpose that he had become a paper millionaire before he was twenty; but, during one of the frequent depressions his paper fortune blew away.[43] Upon Allen's retirement in 1859 Moffat liquidated and paid off creditors and stockholders. There was then in existence a firm of bookdealers and stationers with stores in St. Joseph, Leavenworth and Omaha, owned by C. C. Woolworth of St. Joseph and S. B. Woolworth of Omaha. We may assume that young Moffat was a patron of the latter store, and that he sought by reading to rectify his early lack of educational advantages. His deprivation of these opportunities had left such a deep impression upon his mind that, in later years, he erected a library at his birthplace, and presented a pipe organ to the Blooming Grove church, which he had attended as a boy.[44]

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[40] Idem. March 21, 1860. Byers wrote on this date: "From long acquaintance with Dave we are well qualified and take pleasure in assuring the public that they will find him one of the most accommodating gentlemen they can possibly meet or deal with."

[41] Glasgow church records reveal that Nicholde de Moffat, archdeacon of Teviotdale, became Bishop of Glasgow in 1268 A.D. This family is supposed to have joined the Presbyterians who emigrated to Ireland between 1680 and 1690. David Halliday Moffat's ancestors came to America in 1729. The headstone of Samuel Moffat at Bethlehem, Orange County, New York, reads: "Here lies the body of Samuel Moffat, Deceased. He was born at Balleleag, in the County of Antrim, Kingdom of Ireland, on the 18th day of July, 1704, and he departed this life at Blagg's Cove, in the County of Orange, on the 17th day of May, 1887, aged 82 years, 9 months, 19 days." Samuel Moffat married Anne Gregg, known in family tradition as the "strongest character" in the family. There were twelve children, one the grandfather of David H. Moffat. Andrew Gregg, a brother of Anne, signed the United States Constitution. David was the son of David Halliday Moffat and Eleanor Louise Cutler. The family motto is "Spero Meliora."—I hope for better things. *Denver Republican*, March 19, 1911.

[42] Idem.

[43] Statement of W. G. Evans to the writer.

The Woolworths had conducted an express and mail business with the mining regions thru advertisement in the Denver newspaper, but were in search of a capable young man to open a branch office there. From the combination of circumstances the firm of C. C. Woolworth and David H. Moffat, Jr., was formed.

Even tho prepared by his Omaha experience to meet frontier conditions, Moffat found much to excite his interest in the South Platte settlement. A strange variety of dwellings met his eye wherever he looked. In close proximity, or side by side, new and imposing store buildings of frame or brick jostled hewn log houses, or the more primitive huts of the pioneers of fifty-eight, crude affairs, seven by nine feet, built of unhewn cottonwood poles, with dirt roofs. On occasion, the buffalo-hide tepees of Indians would be found sandwiched between emigrant wagons, much to the terror of the inmates. Yet the town was not wholly destitute of beauty. A noble belt of giant cottonwoods, extending for miles along the banks of the Platte, was in bud and soon would afford grateful shelter from the burning summer sun.

The stores displayed a queer medley of goods. A drug store handled hardware, drugs and groceries; a dealer in mules and oxen offered stationery, while one enterprising merchant advertised "Dried peaches and apples, can peaches and oysters, California saddles and bridles, and a general stock of stationery."[45] In the stores and around the bars of saloons men gathered to discuss the latest gold strikes: "ground still frozen in South Park—one dollar a day to one ounce ($16.00)—new strike on the Blue—averages seventy-five cents to the pan—men crossing the Range on snowshoes—four feet of snow on the pass[46]—five dollars a pan at the twenty-foot depth from the

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[44] *Denver Republican*, March 19, 1911.
[45] *Weekly News*, May 23, 1860, Advertisement.
[46] *Weekly News*, March 7, 1860.

Freeze lode in South Nevada—twenty-five to fifty men a day going to Mountain City—rich lodes discovered there every day."[47] Scraps of conversation such as these floated from every doorway.

Qualms of doubt as to his wisdom in joining the gold rush must have assailed David Moffat as he read with wide-eyed wonder columns of the *Weekly News* the week of his arrival: a duel between two officers of the provisional territory, attended by six to eight hundred spectators, who conducted themselves in "an orderly and peaceable manner" as tho the event were an everyday occurrence;[48] the hanging of a man condemned by the miner's court for murder; his solemn march to the gallows surrounded by a hollow square of Jefferson rangers, stepping slowly to the tap of a drum and the muffled footfalls of the crowd; a word picture of this young man and a pioneer minister praying side by side on the scaffold that God might pardon his sin.[49]

Denver City had small opportunity for mature reflection upon these events—time for that later when the great emigration should have passed. Each week brought fresh evidence that an army was on the march. Early arrivals came by mule team. With better weather the time of passage from the States was considerably shortened, trips averaging from fifteen to eighteen days. The *News* of April eleventh reported that the Express on the sixth had passed six hundred wagons on the road, and on equal number during the night. By mid-May, 1860, ox-teams came rolling in over the Highland hill—after that, the deluge. Each party spent from two to three days in Denver arranging for the storage of heavy baggage until a permanent location had been established, or gazing with eyes as round and ox-like as those of their beasts at men gambling, gold-dust pouches at their sides. The River Front between the Platte and Blake Street was filled constantly with covered wagons, with oxen and mules on tether. Camp-fires, blazing at night, suggested an army at bivouac and gave the only light save rays that streamed from cabin and saloon. A fiddle whanged—a sentimental song quavered on the night air.

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[47] Idem. March 27, 1860.
[48] Idem. March 14, 1860.
[49] Idem.

Moffat early gave leaders in the mining region evidence of his keenness and stability. Thru strict application his business prospered. Subscriptions were taken for eastern papers and, at first, delivered by him in person at twenty-five cents each. Many there were who had come from cultured homes and they abhorred crude living conditions of the frontier; the shallow wells in the yards, dirt floors where, more often than not, beds were made on the ground; bare logs or board walls without covering or adornment. Moffat soon had on the road six thousand rolls of wall paper in varied and handsome patterns.[50] He perceived that the business section was to develop in Denver and moved his store from Auraria to Fifteenth and Blake streets. Frequently, he laid upon Editor Byers' desk copies of St. Louis, St. Joseph and Chicago newspapers, brought by his own freight wagons in advance of the regular stagecoach mail.[51]

The arrival and departure of the mail and fast express coaches were events of the town. Whenever a coach left there was a general gathering of citizens, accompanied by hand-shaking among friends and parting drinks.[52] One fall day in 1861 David H. Moffat indulged in these ceremonies as a voyager and stepped aboard the eastbound coach. A few weeks later he was married, December 11, 1861, in Saratoga, to Fannie A. Buckhout of Mechanicsville, New York, a boyhood sweetheart.[53] They made the trip to Denver by train and stage, a week's honeymoon in a swaying, jolting box, creaking on leather hinges, a journey that only love could find endurable. Upon their arrival in Denver the young couple occupied a two-story frame house on Eleventh Street near Larimer, still standing when these words were written. Roses climbed over the cottage; dark Indian faces often were thrust against the window panes as Mrs. Moffat performed her housework. The couple lived there during the winter of 1862-63, and one child, Marcia, was born to them.

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[50] *Weekly News*, April 11, 1860.
[51] Idem. May 23, 1860.
[52] Idem.
[53] *Who's Who in America*, Vol. VI, 1340.

Moffat's bookstore was in existence six years and during part of that time he served as assistant postmaster to S. S. Curtis and as local agent for the Western Union Telegraph. It was in this period that friendships were formed which were to bring him fortune and power beyond all his dreams. During these first years, before the soul of the West had entered into and become a part of his inner consciousness, he shared the ambition of the average pioneer—a stake, then ho, for the States and civilization!

There were few women on the frontier, so it became customary for young married couples to meet at the homes of friends once a week. At Moffat's cottage in West Denver, upon one of these occasions, the men lingered about the dinner table, smoking and talking. The conversation turned upon the ambitions and business fortunes of those present. Moffat had been silent for several moments, listening to the conversation. Suddenly he turned to A. W. Bailey and looked him squarely in the eye—a way that was characteristic of Moffat.

"Billy," he said, "did you set a stake for yourself when you came out here?"

"I did not think much about what I would do here," replied his friend, "except to make a living and lay up a little money."

"Well," said Dave Moffat, "I set my mark when I started for Colorado. I determined to make seventy-five thousand dollars. When I have done that I will go back to New York and enjoy myself."[54]

Three factors threatened to ring down the curtain upon the drama of empire in Colorado Territory during the early sixties. Foremost was the Civil War, which drained the mining camps of their most experienced labor and left the settlements in a comparatively defenseless condition. The plains Indians took prompt advantage of the situation to go upon the war path from the Black Hills to the Arkansas. The resultant scarcity and high cost of supplies were ruinous to industrial expansion. To increase the general misery grasshoppers appeared in countless millions and devoured growing crops. This was a disaster of no mean importance. Agriculture had reached a point of development that promised to make the settlements self-supporting. D. K. Wall, near Golden, had raised bountiful crops of vegetables by irrigation in 1859-60; John Henderson, at Henderson's Island below Denver, had demonstrated the value of native hay for stock feeding; and on the plains John W. Iliff even then was laying the foundation for his title of "Cattle King," to be bestowed a few years later when forty thousand steers ranged under his brand.[55]

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[54] Hill, *Colorado Pioneers in Picture and Story*, 296.

With the gradual amelioration of these ills at the close of the war, business leaders of the community redoubled their efforts to bring the Pacific railroad thru the Territory. The most industrious in these attempts were Governor Evans in Denver City and W. A. H. Loveland in Golden, who differed only as to the point of entrance to the mining regions. The more substantial of Denver citizens gathered in the evenings at the Broadwell House to discuss the railroad problem.[56] A review of their names would furnish a roster of Colorado's pioneer builders. Among them might have been noted Governor Evans, builder of railroads and founder of universities and churches; Bela M. Hughes, an eloquent lawyer and great organizer, who came to Colorado from Missouri to become associated with Ben Holladay of stagecoach fame; J. S. and J. F. Brown, founders of a great mercantile house; John W. Smith, father of Colorado's milling industry; Luther Kountze, banker; Walter S. Cheesman, who later built the Denver water system; George Tritch, hardware merchant, and many others.

David H. Moffat had ere this won confidence in his sound business judgment, and mingled with these men as an equal. Governor Evans had appointed him adjutant general of Colorado Territory in 1865. This same year, on May tenth, the First National Bank had been opened for business with Jerome B. Chaffee of Central City as president. Chaffee and Eben Smith, one of the directors, had just struck it rich thru their operation of the Bobtail Mine at Central. With these two men Moffat later was to be associated in the mining deals that brought him a large share of his fortune. Two years later the

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[55] *History of Colorado:* Working on "Agriculture," 587; Steinel on "The Range Livestock Industry," 665.
[56] Hill, *op. cit.* Quotes J. S. Brown, 281-283.

First National was reorganized. Moffat's banking experience served him well, and he was made cashier with executive power.[57]

Denver pioneers believed that the Union Pacific could not do otherwise than pass thru their city with its main line. It is not unlikely that they knew the northern route would require less difficult construction, but they counted upon the fact that the Territorial mines were producing the only considerable wealth along the Continental Divide from Canada to Mexico. It was well known that the Union Pacific directors favored the Denver route. In his memoirs, General Grenville M. Dodge, chief engineer of the Union Pacific from 1866 to 1870, referred to this wish in the following words: "The year 1866 was spent in determining the Rocky Mountains or Black Hills route, and the approaches to them from the East. It was the great desire of the company to build their line thru Denver, Colorado, if possible, up the South Platte Valley and crossing the mountains west of Denver, and reaching Salt Lake by the Yampa, White and Uintah valleys, and I covered the country from the Laramie Canon on the north to the Arkansas on the south, examining all the mountain passes and approaches, and examined all these lines personally. These surveys demonstrated that there was no question as to where the line should cross the mountains. The general examination of the plains along the east foot of the mountains showed that the plains rose from the Arkansas north until they reached their apex at the Valley of Crow Creek, near where Cheyenne now stands. They then fell to the north toward the Laramie, and when we came to examine the summits of these mountains, we found their lowest altitude was in the vicinity of the Cheyenne Pass, so that there was no question as to where our line should run."[58]

General Dodge mentioned as the engineers who made these surveys James A. Evans, P. T. Brown, who surveyed the Boulder and Berthoud routes, and L. L. Hills, who had the party on the Cache-la-Poudre and Lodgepole lines.

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[57] *History of Colorado.* Swan and Herrick on "Banking in Colorado," 882. Also see *Denver Republican,* March 19, 1911.

[58] Dodge, *How We Built the Union Pacific Railway and Other Railway Papers and Addresses,* 21.

The Boulder Pass survey was not satisfactory to the chief engineer, who joined the party personally in November, 1866, in order that he might form his own judgment on the ground. Engineers were attempting to locate a line across the pass near the present Moffat Tunnel line, when they were caught in one of the death-laden winter storms above timberline. In describing this experience General Dodge wrote: "We were on this mountain November seventh in a terrific snow storm: one of the worst I ever saw and one we could not make the mules face. I saw to save the party we would have to abandon my pack-train and get into the valley below. We therefore unpacked our mules, cached the packs, and let the mules go. They drifted with the storm. After a day's and a night's hard struggle with the party we got down into Boulder Valley about midnight and into a stamp mill that was being built there by General Fitz John Porter."[59]

About this time Jesse L. Williams, government director of the Union Pacific, who also was an eminent engineer, and Col. Silas Seymour, consulting engineer of the road, visited the Berthoud location on an inspection trip, the latter mentioning a tunnel location in a report written upon his return to the East.[60] They were accompanied by Assistant Engineer Brown.[61] A storm prevented a visit to the Boulder Pass location, but the party met General Dodge immediately thereafter, and the Cache la Poudre and Lodgepole routes were inspected.

General Dodge reported favorably upon the Lodgepole route within a week after having escaped death on Boulder Pass. This report was adopted by the company and the General proceeded to develop the northern survey for construction the following year.[62]

The Pikes Peak pioneers were paralyzed by this fatal blow to their hopes and sank into a dull apathy. There followed a rush of less responsible citizens to Cheyenne, and for a time it seemed that Denver

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[59] Idem. 110.

[60] Seymour, *Western Incidents Connected With the Union Pacific Railroad*, 16.

[61] Brown was shot by Sioux Indians while reconnoitering the basin where the Union Pacific finally crossed the Divide. He had a party of soldiers with him as guard, and realizing that he was fatally wounded, begged his men to abandon him and save themselves. This they refused to do, fighting the Indians off during the day and carrying Brown on their carbines fifteen miles after dark. He died within a few days, one of the heroes of and martyrs to the first trancontinental line. Dodge, *op. cit.*, 300.

[62] The report was dated November 15, 1866 and was adopted November 23 of the same year. Idem. 21.

City was doomed to the sad fate of a boom town. Even such substantial interests as the First National Bank, Kountze Brothers Bank and the Tritch Company opened branches in the Wyoming town.[63]

In a desperate attempt to save the situation for Colorado, Andrews N. Rogers of Central City published, in the spring of 1867, a pamphlet addressed to the president and directors of the Union Pacific Railroad which urged the adoption of a route between South Boulder and Ralston creeks. Provision was made for a tunnel thru the Continental Divide at the Hog Back, a narrow spine on the summit two miles south of the present Moffat Tunnel.[64] This was the first definite mention of a tunnel location thru the Divide north of James Peak of which we have record, altho it is possible that General Dodge's surveys may have provided for such a development. Importance was given the suggestion because of Roger's undoubted qualifications, for until that time he was probably the most widely experienced railroad and mining engineer who had taken up permanent residence in Colorado Territory.[65] His judgment as to location of the tunnel has been confirmed by many surveys within the last fifty years.[66] The route suggested followed Ralston Creek to the summit between this creek and South Boulder; thence it ran to the Hog Back, where the tunnel was proposed at an approximate elevation of ten thousand feet. Descending a tributary of James Creek, the line was to have circled Middle Park far above the Colorado River without losing as much elevation as the existing railroad has done, descend the Bear River and follow the Berthoud-Bridger Trail. Rogers contended that his line would have

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[63] Hill, *op. cit.*, 281. J. S. Brown quoted.

[64] The route outlined was projected by Rogers before he had seen the Hog Back, making his location the more remarkable. The *Daily Mines Register* of Central City, April 6, 1867, reports that Rogers made an accurate survey after publication of his pamphlet.

[65] Andrews N. Rogers was a distinguished Pennsylvania engineer, who had been the original locator of many rail lines in the Blue Ridge and Cumberland Mountains. He came to Colorado in 1864 as superintendent of the famous Bobtail Mine at Central, which laid the fortunes of Moffat's most important mining associates, Jerome B. Chaffee and Eben Smith. Later he was president of this company. While developing the mine he invented and built the first steam sinking plant used; built the first steam pumping plant compound condensing engines ever put under ground, and installed the first successful air drilling plant used for any considerable length of time. Frank Hall (*History of Colorado*, Vol III, 420) in speaking of the skillful treatment of ores developed in Gilpin County, gives Rogers credit as being the chief agent in these advances. Judge Moses Hallett of the Federal Court appointed Rogers one of the three commissioners to settle the dispute between the Rio Grande and Santa Fe over the Royal Gorge in 1877. Rogers also acted in an advisory capacity when Moffat was broad-gaging the Rio Grande thru Eagle Canon and the Grand Canon of the Arkansas. *Denver Post*, September 24, 1903, article by Frank Hall; *Steamboat Pilot*, June 28, 1922. Mss. of F. N. Rogers, son of A. N. Rogers.

[66] "Notwithstanding the reports from here and there that there are better routes . . . the Moffat Tunnel is being built exactly where engineers for various interests and at various times for more than fifty years have finally decided upon as the shortest and best point to penetrate the Range." Quotation from a letter by President W. P. Robinson of the Tunnel Commission, published in the *Steamboat Pilot*, June 28, 1922.

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less total elevation than the Union Pacific with its four summits; that this would make for economy by permitting concentration of power at one point; that, with its tributary coal, mining, timber, agriculture and oil resources, it would have more productive territory than the Wyoming route; that it was more free from snow. In the light of General Dodge's experience the year before on this same pass the latter contention doubtless carried little weight with the company directors.

The communication failed to change the determination of the Union Pacific which at one time had been headed for Berthoud Pass.[67] Several spasmodic attempts were made in Denver to organize railroad companies with the avowed object of crossing the Divide but these failed to arouse serious interest.[68]

A comparatively trivial incident aroused the fighting blood of the Colorado pioneers. Word was brought that Vice-President T. C. Durant of the Union Pacific, in the course of a casual conversation, had remarked that Denver was "too dead to bury."[69] A bomb could not have had more instantaneous effect. Stung from their apathy, the iron-willed leaders went into action with the spirit that has developed in a transportation eddy a great American commonwealth, one hundred miles from the nearest transcontinental carrier. Event succeeded event with amazing rapidity. On November 11, 1867, the day that the Union Pacific reached Cheyenne, Wyoming, a Board of Trade was organized which, in turn, formed the Denver Pacific Railroad & Telegraph Company. Officers chosen included: Bela M. Hughes, president; W. F. Johnson, secretary; David H. Moffat, Jr., treasurer. Joseph E. Bates, William M. Clayton, John Evans, Bela M. Hughes, W. F. Johnson, Luther Kountze, David H. Moffat, Jr., John Pierce and John W. Smith were named directors. Three hundred thousand dollars in subscriptions were pledged at a mass meeting held the next day. The County of Arapahoe later voted five hundred thousand dollars in bonds. An agreement was reached with Durant & Dillon, contractors for the Union Pacific, by which they were to iron the road when local interests had built the grade. Evans was sent to Washington to negotiate for a land grant. Eventually a pool was formed by stockholders of the Denver Pacific and Kansas Pacific whereby Kansas Pacific lands between Denver and Cheyenne were transferred to the Denver Pacific. Upon completion of the Denver Pacific grade, the Union Pacific refused to keep its agreement. Again disaster seemed imminent. Evans and Pierce could find no one in the East who would buy bonds. When hope seemed at an end, Governor Evans and Robert E. Carr, president of the Kansas Pacific, took a contract to complete the line. The first construction engine, bearing upon its cab the name of David H. Moffat, steamed into Denver, June fifteenth, and nine days later the line was opened for traffic. A Kansas Pacific train rolled in from the eastward August fifteenth of the same year, bringing three hundred tourists from the Mississippi Valley. The Boulder Valley Railroad, from Hughes Station (Brighton) to Boulder, was completed the following year. Moffat was treasurer of this line and built the extension from Boulder to Marshall to give Denver an adequate supply of coal.[70]

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[67] Loveland secured a charter for the Colorado & Clear Creek Railroad in 1865, the year following incorporation of the Colorado Central. Provision was made for a connection with the Union Pacific, and the name of President John A. Dix of the latter road appeared as one of the directors. *Territorial Session Laws of Colorado*, 1865.

[68] A. N. Rogers and associates incorporated the Gilpin, Jefferson & Boulder Coal & Ore Railroad & Wagon Road, March 27, 1871. Records of the Secretary of State. Doc. 570. Book D, 245.

[69] Bailey, *The First Transcontinental Railroad*.

Upon conclusion of these events, which created the wildest enthusiasm in the Territory, the mining regions burst from their swaddling clothes with astonishing energy. Within the next decade the Territory had become a state and had grown in population from thirty-nine thousand to one hundred ninety-four thousand, while Denver had expanded from five thousand to thirty-five thousand.[71]

There followed the most intensive period of railroad development in the history of Colorado. Up to 1885 two hundred and four articles incorporating railroads had been filed with the territorial and state secretaries.[72] General William J. Palmer, the great engineer of the Kansas Pacific, had never been converted to the Denver terminus for that road. He believed that its brightest outlook was in the direction of Santa Fe. That he was right in his analysis none may deny, for the road would have anticipated the Santa Fe and secured the business of the Southwest. General Palmer remained in Denver, where he conceived a plan for a railroad that should run from that city to Mexico City, paralleling the Front Range of the Rockies and draining their resources thru branch lines extending westward up the main waterways. He and associates incorporated the Denver & Rio Grande Railroad October 27, 1870. Before he could fully execute his plan, the Santa Fe, thru a subsidiary corporation, built into Rio Grande territory, and there followed the famous war for possession of the Royal Gorge. The Rio Grande won but the Mexico City projection had to be abandoned. The road rapidly grew to the westward, serving with its branches Southwestern Colorado and the Western Slope. General Palmer and Col. D. C. Dodge, his general manager, together built the Rio Grande Western, forming a junction with the parent company's Marshall Pass line at the Colorado-Utah border in 1883, and thus establishing the first thru route between Denver and Salt Lake City. The Tennessee Pass connection had not been made at that time.[73]

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[70] *Denver Republican*, March 19, 1911.
[71] Charter of the City and County of Denver, 1916, II.
[72] Ridgway, *op. cit.*, 818-841.

Altho defeated in its contest for the Arkansas route, the Santa Fe, in one guise or another, continued its attack upon Rio Grande strongholds long after the Royal Gorge incident. Its most important threat was construction, thru a subsidiary, of the broadgage Colorado Midland, which went from Colorado Springs by way of Ute Pass, South Park, Buena Vista, Hagerman Pass, with one fork to Newscastle and one to Aspen. Later it operated a joint track with the Rio Grande between Newscastle and Grand Junction.[74] While never a success because of steep grades and high curvature, the Midland was the factor that finally brought about the broadgaging of the Rio Grande main system. An interesting feature in Midland history was the construction of the Busk-Ivanhoe Tunnel thru the Sawatch Range, connecting the Atlantic and Pacific slopes. Work was started August 1, 1890, by a private corporation which made the fatal mistake of undertaking it without having first secured a contract for use. The length of this tunnel was nine thousand, three hundred ninety-four feet; the saving in elevation five hundred thirty feet; the saving in distance, seven miles. The Midland was in financial difficulties then and could not pay the rental demanded by the owners, the company went to the wall and the Midland later secured the bore for a fraction of the original cost.[75]

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[73] Idem. 828.
[74] Idem. 841.

While Palmer was fighting the Santa Fe, a rival even more dangerous to Rio Grande interests, made its appearance. This was the Denver, South Park & Pacific Railroad, backed by the formidable group of men who had built the Denver Pacific and diverted the Kansas Pacific from its true course. Governor Evans was president of the new road, David H. Moffat was treasurer. Governor Evans had studied his maps until he had discovered that Denver is a focal point, practically equidistant from St. Louis to San Francisco, the Gulf of Mexico to Puget Sound, and Chicago to San Diego. Upon this premise he predicated a daring plan to build radial lines to the points enumerated, with Denver as the hub of an enormous transportation wheel. The South Park was to be the first spoke. The road was built to Buena Vista in 1879 and operated a joint track to Leadville with the Rio Grande in time to participate in the great Leadville boom.[76] The following year, Jay Gould, then interested in the Rio Grande and a fourth owner of the South Park, bought out the local stockholders of the latter road. He had acquired depreciated Kansas Pacific stock at a bargain and used his new acquisition with telling effect as a threat against the Union Pacific. The latter road promptly came to terms and thru a merger, came into possession of the Kansas Pacific, Denver Pacific, South Park and Boulder Valley lines. Evans, Moffat and their associates realized over three million dollars on their holdings, this having been the most lucrative railroad investment that Moffat ever made.[77]

The Union Pacific, for reasons of its own, promptly relinquished the valuable joint trackage rights with the Rio Grande, and built a circuitous line over Boreas Pass from South Park to Leadville. It reached the latter point in 1884,[78] thus losing three years of Leadville traffic and an immense commercial advantage. The South Park was never thereafter a threat to the Rio Grande. Almost immediately after the sale, Evans, Moffat, George Tritch, J. F. Brown, George W. Kassler and C. B. Kountze, inaugurated the second spoke in the transportation wheel—the Denver & New Orleans Railroad.[79] Once more Palmer found himself facing a strong competitor, this time in the direction of the Southern Colorado coal fields. But the Denver financiers were in a more dangerous situation. Not alone did they have the Rio Grande to oppose, but the Santa Fe and Union Pacific as well. After many vicissitudes of fortune the promoters lost control and the road, as the Union Pacific, Denver & Gulf, passed to the Union Pacific, there to remain until the octopus went into receivership. Eventually the South Park, the Denver & Gulf and Loveland's Colorado Central system all passed to Burlington interests, where they remain today as the strong Colorado & Southern system.

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[75] Idem. 829-830.

[76] Idem. 830.

[77] The plan of Governor Evans and many facts upon which South Park history, as stated in the foregoing is based, appear in detail in the author's *Life of Governor Evans*.

When past eighty years of age, Governor Evans attempted to finance the third spoke in his magic wheel—the Denver, Sioux City, Lake Superior & Chicago railroad—but met with no success other than a nominal endorsement by the Denver Chamber of Commerce, following a report to that body in 1894. Actually he had passed from the picture as a dominant force in the Colorado railroad situation some ten years earlier; or, approximately when the Gould interests had acquired control of the Rio Grande and eliminated from its affairs that genius of mountain railroad history—General William J. Palmer. Without the loss of a revolution in its eternal spin the wheel of empire in Colorado turned upon a new fulcrum. Ripened in experience thru his intimate connection with the pioneer railroad history of the State, David H. Moffat stepped to the industrial throne of Palmer and Evans.

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[78] Ridgway, *op. cit.*, 831.

[79] Idem. 832. The road was incorporated January 25, 1882.

CHAPTER III.

CONDITION OF COLORADO WHEN MOFFAT ASSUMED INDUSTRIAL LEADERSHIP — AGRICULTURAL DEVELOPMENT—MOFFAT'S FORTUNE MADE IN MINES—GENEROSITY TO FRIENDS—SOME EARLY PLANS TO TUNNEL THE DIVIDE—BURLINGTON VENTURE FAILS—MOFFAT'S FAITH UNSHAKEN—PRESIDENT OF THE RIO GRANDE—ATTEMPTS TO DIVERT ITS COURSE — BROADGAGES SYSTEM—HIS CONSTRUCTIVE VIEWPOINT—CRIPPLE CREEK INTERESTS — BANKING OPERATIONS REVEAL VISION—PANIC OF NINETY-THREE AND MOFFAT'S HEROIC ATTITUDE—GROWTH OF PUBLIC UTILITIES—THEIR CONNECTION WITH THE MOFFAT TUNNEL.

THE last American frontier really came to an end in the State of Colorado about the year 1880. There have been localized instances at later periods, of course, that have reflected true frontier conditions, of which the most interesting was the Alaskan gold rush; but nowhere has there been seen the spectacle of a nation shifting its center of population in one concerted movement, nowhere in the world can such a marvelous thing come to pass again. Coal and iron have changed the nature of colonization.

David H. Moffat, who became president of the First National Bank of Denver this year, was only forty years old when he assumed industrial leadership in Colorado. Two years' service as territorial treasurer, from 1874 to 1876, had taught him that political office is but a snare to the man who would be architect of state. Never again would he consider nomination for a public office, tho at any time during twenty years, a nod would have made him United States senator.

Thru his strategic position in the First National, Moffat had been able to keep his finger upon the pulse of industry. Himself heavily involved in construction of the pioneer, intra-state railroads, he had watched their tenuous lines of steel reach out to the coal fields of Southern Colorado, of Canon City, Crested Butte and Gunnison; had seen the birth at South Pueblo of General Palmer's steel plant, unfailing barometer of manufacturing.[80] He had observed in 1867 the introduction of Prof. N. P. Hill's experimental copper matte smelter in Blackhawk;[81] the consequent elimination of the waste in mining; the growth of a great smelter industry, totaling twenty-five distinct plants by 1880.[82] Leadville had shed its silver light upon an astonished world and during this year, was to double the precious metal production of the state.[83]

On the great plains the buffalo had been followed by the Texas longhorn; in turn the "dogie" had given way to the thorobred shorthorn.[84] The fable of the Great American Desert finally had died when the Greeley colonists turned the soil of the South Platte Valley and found that the magic of irrigation could transform the barren sandhills into gardens of plenty.[85] Bountiful crops of corn, wheat, oats, barley, rye, potatoes, thru the agency of water, succeeded buffalo grass, cactus and sand-burrs, and the science of agriculture ended the reign of the despotic grasshopper. A great milling industry had come into being.[86] Horticulture had begun to arouse interest and in 1880 the famous Rocky Ford melons were first to receive recognition as a specialized crop.[87] In this year, too, wool production was to commence a phenomenal growth.[88] In the brief space of twenty years Moffat had seen all these changes come to pass; had been party to a drama of man and nature that would have moved a Homer to song. Small wonder then that he burned with the creative purpose to spread this productivity to the undeveloped empire beyond the Divide.

Most significant of all events, however, as indicative that the

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[80] The Colorado Coal & Iron Company, forerunner of the Colorado Fuel & Iron Company, was organized January 23, 1880. Two years later the first rails were rolled and a nail mill started. Henderson on "Mining," *History of Colorado*, 569.

[81] The Boston & Colorado Smelting Company's plant "revived the waning mining industry of Colorado." Idem. 532-535.

[82] Idem. 538.

[83] The total production of metals in Colorado jumped from $9,197,252 in 1879 to $18,593,025 in 1880, silver production showing an increase the latter year of $8,000,000, most of this from Leadville. Idem. 541.

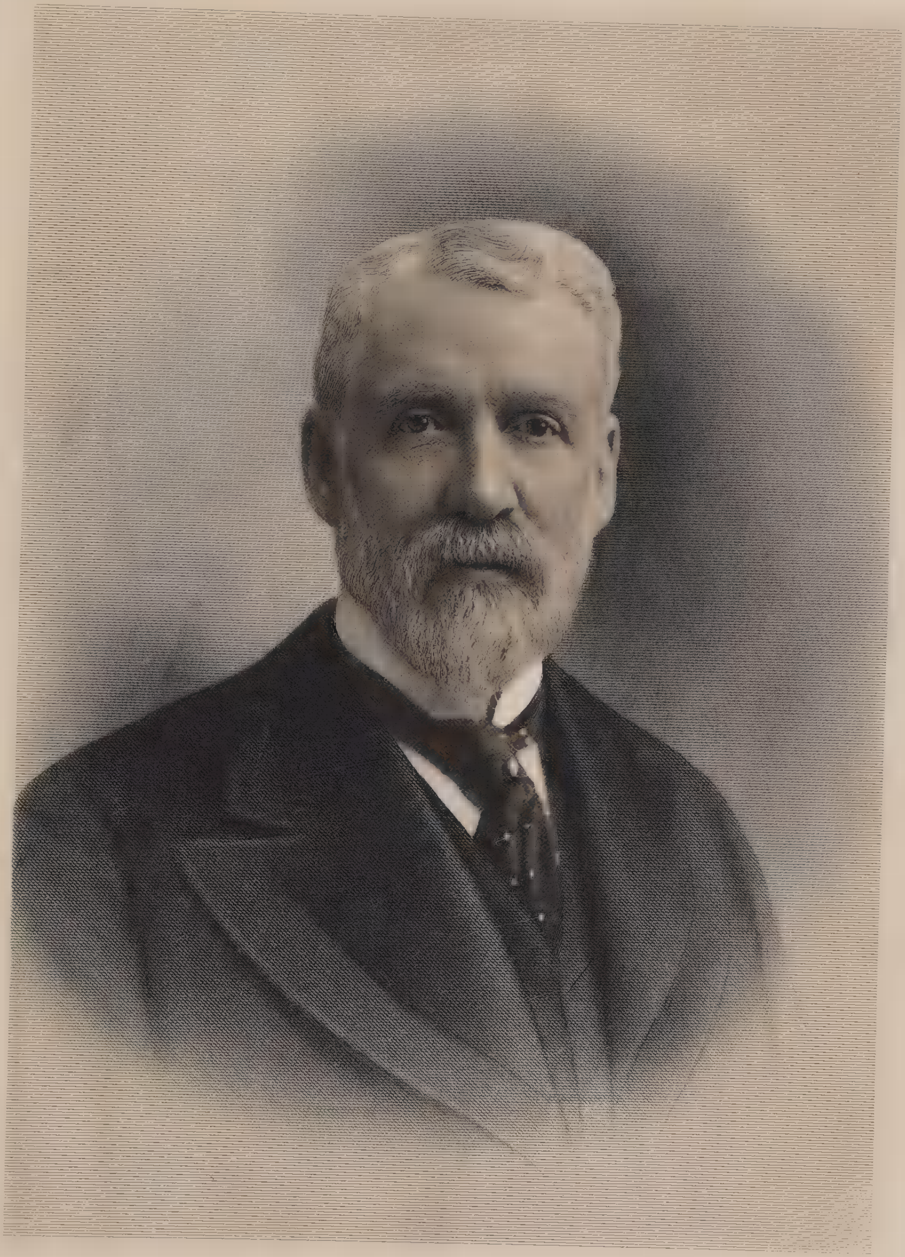
[84] John W. Iliff, largest individual cattle raiser in the state, introduced purebred shorthorn bulls to breed with Texas cattle. Iliff held the Platte Valley range. South of the Arkansas the Prairie Cattle Company, a Scotch corporation, had on three ranges, 139,000 head in 1883. Steinel, *op. cit.*, 666-667.

[85] The Union Colony, founded in April, 1870, attacked the problem of agricultural development in a more intelligent manner than other colonies. Irrigation was developed on a large scale and the question of crop rotation received thoro attention. Working, *op. cit.*, 587-598.

[86] J. K. Mullen bought the Excelsior Mill from John W. Smith in 1879. This was the inception of the Colorado Milling & Elevator Company. Working, *op. cit.*, 593.

[87] George W. Swink of Rocky Ford shipped 200,000 pounds of watermelon from his farm in 1880. Idem. 637.

[88] Range sheep in 1880 numbered 110,000 in Colorado; in 1886 the flocks held 2,000,000 head. Steinel, *op. cit.*, 675.



EBEN SMITH

frontier had passed, never to return, was the removal of the Indians from Western Colorado to a reservation in Utah following the Meeker massacre in 1879. Long ere this Arapahoes and Cheyennes had been forced from the open range, but the mountain Utes had remained lords and owners of the land west of the Divide.[89] When the Utes filed across the Utah-Colorado border with their ponies, dogs, tepees and arms, the last impediment to the advancing tide of civilization was removed. Within two years thereafter, several towns had been founded in the Gunnison Valley.

Moffat is ranked by historians as among the largest mining operators that the state has produced, most authorities placing the number of mines owned entirely by him, or in conjunction with others, at more than one hundred. Strangely enough he was interested only incidentally in the Central City field, altho that is where his future partners, Senator Chaffee and Eben Smith made their start. Friendship rather than a desire for gain, led to this venture. Bela M. Buell, one of the organizers and largest stockholders in the First National Bank, had sold his stock and invested the proceeds in the Kipp and Buell mine. Like many of the pioneers he was a free spender and by 1876 had fallen into financial difficulties. He appealed to his friends. Moffat and Andrews N. Rogers came to his relief, investing considerable sums in the Kipp and Buell in order to save the mine to its owner. Moffat's first large stake in the mining industry came from the Caribou silver mine in Boulder county. This had been a great producer, but thru mismanagement had deteriorated and filled with water. Moffat, Chaffee and Smith acquired the property in 1876, Smith taking personal charge of operations. The latter was a mine manager of exceptional ability. His association with Moffat covered a period of about forty years, and the latter depended implicitely upon the judgment of Eben Smith in all his operations. Smith soon placed the Caribou in splendid condition and it continued to produce handsomely for many years.[90] When the value of the lead-carbonates at Leadville was discovered, Moffat, Chaffee and Smith were among the first in the field. They bought one-half interest in the Little Pittsburgh, November 18, 1878, acquiring August Riche's holdings for two hundred sixty-two thousand, five hundred dollars. This made them partners of H. A. W. Tabor, and a new company, the Little Pittsburgh Consolidated, was organized to include the mine from which the company took its name, the New Discovery, Dives and Winnemuck. From the date of discovery until July 1, 1879, alone, the actual yield from ore sold to the smelters exceeded three million dollars.[91] In the latter month Moffat and his associates bought the Robert E. Lee bonanza for two hundred forty thousand dollars. In a few months the profits had passed the purchase price.[92] These deals give a very inadequate idea of the magnitude of the banker's operations in the mining field, which continued thruout the Creede, Aspen and Cripple Creek booms. His greatest good fortune in Leadville came from the Maid of Erin, which he owned in conjunction with Eben Smith. The group included the Maid of Erin, Wolftone and Louisville. During the eighties, Moffat became interested with Walter S. Cheesman in the Franklin silver mine at Aspen, known locally as the "Deep Shaft," a valuable producer as long as the silver market remained high.[93]

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[89] Goodykoontz, *op. cit.*, 459.
[90] Fossett, *op. cit.*, 262-263.

Frequently when completing a mining deal, Moffat would set aside an interest for a friend, often unknown at the time to the individual favored. If the investment turned out unfortunately, Moffat bore the loss. He once reserved a block of stock in a Leadville mine for Sylvester T. Smith, an old associate of Denver Pacific days. This mine proved to be very rich and Smith's profit amounted to seventy-five thousand dollars. The latter knew nothing of the transaction as he had been in New York for some time. One day the cashier of the First National came to Moffat and said: "What do you suppose that fellow Smith has done? He has drawn on us for fifty thousand dollars."

"Well," was the calm rejoiner, "His account is good for it, isn't it?"

"Yes," replied the cashier, "but he does not know it."

"Don't suppose he does," said Moffat, "but he knows I am here.

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[91] Idem. 450-453.

[92] Idem. 462.

[93] This information was furnished the writer by E. W. Keith of Denver, mining engineer associated with Moffat in development of the Maid of Erin.

He is probaby helping a good fellow out of a hole and knows I'll not go back on him."[94]

On another occasion Moffat is reported to have given George E. Ross-Lewin, vice-president of the First National, one hundred thousand dollars as a present. But, perhaps the most characteristic incident related to illustrate his open-handed generosity took place in New York years later. The head waiter of the Belmont Hotel, who had pleased the banker by his unostentatious manner, one day expressed the desire to own a western ranch. The next morning Moffat handed him a deed to a fifteen thousand dollar ranch in Routt county.[95]

Departure of the Utes from Western Colorado, previously mentioned, and the surveys of Major John Wesley Powell of the United States Geological Survey served to focus attention of business leaders upon the Western Slope. Doubtless as a result of these events, several efforts were made during the eighties to cross the Continental Divide west of Denver with a railway.

Many random statements have been made of late years intended to give to others than David H. Moffat credit for conception of the Moffat Railroad. While it is hardly necessary to refute these tales here, one of the attempts mentioned was of so spectacular a nature and so much in point, withal futile, that it is worth relating.

On December 11, 1880, the Denver, Utah & Pacific Railroad Company was incorporated under Colorado laws for the purpose of building a railroad from Denver over one of the Continental Divide passes north of James Peak; thence thru western Colorado and Utah to the Pacific Ocean.[96] Except for details of location the route projected was identical with the present route of the Denver & Salt Lake Railway (Moffat Road) in conjunction with the Dotsero Cut-off. The list of incorporators represented the most powerful group of capitalists in the state and a survey of the names will convince anyone familiar with Colorado wealth of the eighties that they were good for the announced capitalization of thirty million dollars. These men were: George Tritch, Walter S. Cheesman, Charles Hallack, Assyria Hill, William Barth, J. F. Brown, A. B. Davies, George W. Clayton, David H. Moffat, Jr., J. W. Richards, H. A. W. Tabor, Fred Z. Salomon, H. B. Everest, C. Strong, William H. Bush, James Archer, E. F. Hallack, J. A. Brinker, John L. Routt, W. J. Kinsey, W. B. Daniels, James Duff, J. A. Cooper, Francis L. Carter-Cotton, Henry R. Wolcott, C. H. Smith and J. W. Smith. Mining magnates, merchant princes, large real estate operators, a past and future governor of Colorado and a future United States senator were among the subscribers.[97] Most spectacular was Tabor, mining Croesus of Leadville.

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[94] Hill, *op. cit.*, 297-298.

[95] *Rocky Mountain News*, October 10, 1902. Quotes from *Cosmopolitan Magazine*.

[96] The incorporation papers read: "for locating, constructing, owning, maintaining and operating for the transportation of freight and passengers, and other purposes, single or double track narrow-gauge railroad, or part of it both narrow and broad gauge, if deemed expedient, and a telegraph line, commencing at and starting from the City of Denver in the County of Arapahoe, State of Colorado, passing thru the counties of Jefferson, Weld, Boulder, Grand, Summit and Gunnison, in the State of Colorado to the eastern boundary of the Territory of Utah, passing thru the coal fields southwest of Erie, and by or near the town of Erie in Weld County on its route to the mountains, and thence by the most feasible and direct route to and up the eastern slope of the Rocky Mountains by either the Big Thompson, Boulder, Cache-la-Poudre, or St. Vrain River passes, and over the Front or Snowy Range and Continental Divide of said Rocky Mountains to or near the Hot Sulphur Springs in the Middle Park, or Grande (Colorado) River, Grand County, thence down the Grande River, passing the junctions of Williams River, Blue River, Piney River, Eagle River, Roaring Fork River, and Eyrie Park and Defiance City to the western boundary of the State of Colorado, on the most feasible line to be determined by survey; thence through Utah Territory, and to be extended to the Pacific Ocean in the State of California." Records of the Secretary of State, Doc. 3181, Book 4, 170.

Altho the origin of this venture is buried in the past, in view of Moffat's clear record of thirty years' interest in a trans-divide railroad, it is reasonable to suppose that he had much to do with the inception. Certainly no other man in the group had played so prominent a part in Colorado railroad history, nor was any other later to be so prominently identified with railroad construction in Colorado. We assume, therefore, with little fear of contradiction, that the Denver, Utah & Pacific was David H. Moffat's first direct, tangible attempt to build a railroad to the Western Slope by way of Rollins Pass. A line was surveyed thru the mouth of South Boulder Canon with a four per cent grade and a forty degree curvature, according to one authority, tho the curvature mentioned seems too sharp to be accepted with any degree of faith.[98] Streeter & Lusk, afterwards contractors on the Moffat Road, took the contract. The road started at New Haven and Hartford Streets in Denver and was built and operated as far as Louisville. The grade was not continuous, but parts of it still may be traced at Semper, Pactolis, Rollinsville, Mammoth and Yankee Doodle Lake, the latter now circled by the Moffat Road on its climb to the summit. The old tunnel thru a preliminary ridge before the main Divide is reached is represented by the dump extending into the lake from its western shore. Construction continued until 1882 when Streeter took part of the grade for debt. The Burlington bought the remains and used the grade from Utah Junction to Burns Junction on its Lyons branch.[99] Announcement of Burlington plans for a line thru the same section doubtless had considerable to do in causing abandonment.

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[97] John L. Routt, governor, 1876-1879; Job A. Cooper, governor, 1889-1891; H. A. W. Tabor, U. S. Senator, 1883. *History of Colorado* (authorized by the State Historical and Natural History Society), 1289.

[98] *Denver Republican*, October 2, 1904.

The Denver & California Short Line Railroad, incorporated August 15, 1882, was an attempt to cross the Continental Divide near Argentine Pass. This route was projected by George A. Crofutt, a Pennsylvania engineer, who promoted the company.[100] It provided for a railway, telegraph, pipe, irrigating and ditch corporation to supply mines, fields and domestic users with water, and to give direct means of transportation to the Coast. The plan to bring water thru the Moffat Tunnel from the Western Slope in order to supply domestic users in Denver was anticipated by Crofutt as long ago as this. The survey passed Green Mountain, Bergen Park, Vance Creek and Mount Evans; thence took a westerly course to Decatur in Summit County to the junction of the Grand and Green Rivers. Crofutt surveyed the line in 1883-84, locating the first division of seventy-one miles. A tunnel was contemplated. The promoter contracted for placing five million dollars worth of bonds thru a Philadelphia banker but owing to premature publication of the plans, the company was bankrupted and with it the American Loan & Trust Company of New York, which had agreed to take them. Surveys of the first division were sold to Mark M. (Brick) Pomeroy.[101]

Pomeroy, a real estate operator, promptly organized the Atlantic & Pacific Tunnel Company, capitalized for seven million dollars.[102] His fertile brain seized upon and expanded Crofutt's idea, and his prospectus provided for a tunnel thru the Continental Divide "to work mines, mills and furnaces in the Counties of Clear Creek, Summit, Park, Lake, Gunnison, Hinsdale, Ouray, Garfield and San Juan." "Brick" Pomeroy announced that the company expected to pay expenses of construction and dividends from the gold veins to be cut in the heart of Gray's Peak. He is said to have induced a number of poor people to invest at ten dollars per share. Later his oily tongue persuaded Col. William F. Cody (Buffalo Bill) to pay his expenses to London in the hope that he might finance his project there. He placed the seven million dollars in gold bonds in the hands of Major John M. Burke, Cody's manager, as security. Possibly these may be among Colonel Cody's memorial relics.[103]

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[99] Idem.
[100] Records of the Secretary of State, Doc. 5083, Book 9, 455.
[101] *Denver Times*, March 25, 1902. Quotes George A. Crofutt.
[102] Incorporated February 14, 1884, Doc. 6192, Book 8. 375. Secretary of State.

The Chicago, Burlington & Quincy Railroad, which had completed its Denver connection by 1882[104] made the most ambitious effort to solve the Colorado short line problem prior to construction of the Denver, Northwestern & Pacific. Only an industrial upheaval prevented success. Thru a subsidiary, the Colorado Railroad, incorporated April 5, 1883, surveying parties were placed in the field in the summer of 1884, after the filings, surveys and physical property of the Denver, Utah & Pacific had been acquired by purchase. There were four of these parties, each equipped with pack train, and all under the general direction of Milton Walworth Ensign, one of the most able locating engineers in the history of western railroad construction. The engineers remained in the field for three years, making very complete surveys over Rollins Pass and down the Colorado River by way of Gore Canon as far as Glenwood Springs. H. A. Sumner, later chief engineer and locator of the Moffat Road, was in charge of a party on the west side of the Divide in the James Creek sector. A three-mile tunnel was located between the headwaters of the South Boulder and James Creek, approximately the Rogers' tunnel projection of 1867 thru Rogers Pass. This was to be driven at an elevation of nine thousand, seven hundred feet.[105] In addition a location was made for a five-mile tunnel.

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[103] *Denver Post*, February 19, 1914.

[104] Ridgway, *op. cit.*, 831.

[105] Letter of F. T. Darrow, assistant chief engineer, C. B. & Q. R. R., April 20, 1927.

The line from the plains up South Boulder Creek was located in 1884-1885 by a party of sixteen men in charge of W. K. McFarlin. From original notes on this work, kept by one of the party, W. E. Bogart of Denver, we learn that a two per cent grade and ten degree curvature was attained. Surveys for the tunnel crossed the Divide October 26, 1884, at an elevation of twelve thousand, two hundred twenty feet, sixty feet higher than the Moffat Road rails on Rollins Pass. The Burlington, however, never contemplated a temporary line over the hill but intended from the first to drive a tunnel. The high tunnel location was to be used and was to cost approximately three million, two hundred ninety two thousand dollars.[106]

While the McFarlin party was encamped on a tributary of the South Boulder, some two miles south of the present town of Eldorado Springs, it was trapped one morning by a forest fire. The camp luggage was packed upon the burros and sent with a guard of six men down the Canon. The other members of the party, having delayed their start for a few moments, suddenly found themselves circled by a wall of flames. For the better part of a day they battled the blaze and, when finally success was won by superhuman efforts, an oasis of timber three hundred feet in diameter was all that remained of the thick forest that had encompassed them. The six men sent with the camp equippage also were trapped and escaped by bursting thru the flames to the summit of a barren hill. At this time the Front Range teemed with game upon which the parties depended for fresh meat.[107]

The locomotive engineers' strike on Burlington lines in 1887 forced suspension of operations after a considerable amount of grading had been completed. While Moffat was president of the Rio Grande that road purchased the prior rights, filings and old grade of the Burlington between Glenwood Springs and Elk Creek. The Rio Grande double track occupies part of this grade today.[108] From one source comes the information that one-half million dollars was expended by the Burlington on this ill-fated project.[109]

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[106] Notes of W. E. Bogart.

[107] Letter of W. E. Bogart, dated November 27, 1884, published in the *Western New Yorker*, Warsaw, New York.

[108] Purchase agreement dated December 24, 1888; consideration $26,551.50.

These failures did not lessen Moffat's faith in a transcontinental line thru or over the Divide, which would avoid the big bend of the Rio Grand thru Pueblo. An opportunity to use an established road, the Denver & Rio Grande, as a basis for further experimentation soon was to present itself. There was additional advantage in this because the road mentioned had Pacific Coast connections, and the classification and annual volume of its tonnage was known.[110]

Early in the eighties the Rio Grande had passed from the control of General Palmer to Jay Gould, as stated before. The Royal Gorge War, several seasons of heavy snows, and other misfortunes had played havoc with its finances and caused a default on the bonds in July, 1884. The road went into receivership while Frederick Lovejoy was president. W. S. Jackson was appointed by Judge Hallet of the Federal Court as receiver. Moffat meantime had succeeded on the directorate Col. D. C. Dodge, Palmer's general manager and right-hand man, under whose direction the original Denver & Rio Grande Western had been constructed. Jackson proved to be a capable steward, and was elected president when the receivership terminated July 1, 1886. Altho he left approximately one million dollars in the treasury, the road was in poor physical condition because of long neglect. This condition was to be remedied as thoroly as Harriman reconstructed the Union Pacific in later years. Moffat was elected president of the Rio Grande in 1887 and brought with him as vice-president and general manager Sylvester T. Smith, general superintendent of the Union Pacific.[111]

Construction of the standard gage Colorado Midland, begun in 1885, had created a new situation in Colorado railroading. "It had become apparent if the Rio Grande were to occupy an important place among the rail transportation lines of the West it must move quickly and decisively in standard gaging its lines."[112] Moffat had long wanted to standard gage west of Denver and took prompt advantage of his opportunity. Before his retirement a large part of the present standard gage track on this line had been completed, including the trunks to Trinidad and Grand Junction. A brief summary of mileage, from 1887 to 1892 will cover work completed or inaugurated during his presidency.

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[109] *Denver Republican*, October 2, 1904.

[110] A forty-five year table of major classes of freight moved over the Rio Grande, ending in 1926, shows the preponderance of mining shipments: Mines, seventy-five per cent; agriculture, five per cent; forests, four per cent; animals, two per cent; manufacturing, fourten per cent. Ridgway, *op. cit.*, 867.

[111] Sylvester T. Smith first came into western railroad history as an accountant and cashier of the Kansas Pacific in 1864; later he became receiver of this road. When the Union Pacific took control in 1880 he was made general superintendent of the Kansas Pacific and then of the Union Pacific. He died in Chicago, June 18, 1911.

January 1, 1887—1,562 miles of narrow gage track; 123 miles of three-rail track (Denver to Pueblo).

January 1, 1892—965 miles of narrow gage; 805 miles of standard gage; 296 miles of three-rail track.[113]

When Moffat gave up executive direction the Rio Grande system was in such exceptional condition that it was known thruout the country for its splendid roadbed and rolling stock.

The most interesting phase of Moffat's Rio Grande connection, in the light of his later activities, was the systematic search of the Divide south of Berthoud Pass to locate, if such existed, a better pass than Rollins. All previous efforts of any importance had been centered upon a route directly west of Denver, but as it seemed more feasible in connection with the Rio Grande to utilize as much of the operated line as possible, Moffat now approached the problem from a new angle. There were two plans uppermost in his mind: First, a short line beginning at Acequia, a few miles south of Denver, that would follow Platte Canon, cross South Park and terminate at Buena Vista. The survey followed the South Fork of the South Platte, whereas the South Park had taken the North Fork. Except for this departure the line would have been a repetition of the latter road, which Moffat had helped to build. Consent of the New York directors for construction of the Denver Short Line was secured and a considerable amount of grading completed in South Platte Canon. It soon became apparent that the cost of construction would exceed the original estimate by a very large figure—so large, in fact, that Moffat would not ask for extension of the budget and dropped the work entirely. This plan had certain strong features of which the most impressive were that it would have saved more than one hundred miles in distance, and by elimination of the Palmer Lake Divide, a total rise and fall of four thousand two hundred seventy-eight feet between Denver and Pueblo. However, the Short Line would have cost in excess of seventy-one thousand dollars per mile, while the total construction would have exceeded eight million dollars.

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[112] Ridgway, *op. cit.*, 847.

[113] Records of the Chief Engineer, Denver & Rio Grande Western Railroad.

Moffat then conceived a line across the Continental Divide that would take a more westerly course and cross the Range north of Tennessee Pass. Under the direction of John Morton, a brilliant locating engineer of the eighties, five passes were surveyed: Argentine Pass, south of Gray's Peak; Montezuma Pass, Grizzly, Georgia and Alicante Pass. The first four lines eventually emerged on Blue River, crossing the Gore Range, and descending Gore Creek to Minturn on the Main line. Alicante Pass, in the Park Range between South Park and Blue River necessitated a crossing at Fremont Pass. The line would have joined the main route on Eagle River just west of Tennessee Pass.

The estimated cost per mile of any one of these high pass routes was approximately ninety-four thousand dollars, while the total construction cost would have been about sixteen million dollars. An average distance of one hundred twenty-five miles would have been saved between Denver and Minturn. The cost of the Continental Divide surveys was eighty-four thousand, four hundred fifty-nine dollars; that of the Denver Short Line twenty-one thousand, nine hundred fourteen dollars, or a total of one hundred six thousand, three hundred seventy-four dollars.

In the light of this information the decision was reached to proceed with improvements on the operated line, and this was done accordingly in 1891 and 1892. As compared to the amount necessary to lower grades and shorten line all of the projects enumerated were considered excessive and prohibitive. Some authorities have accepted the expenditures for surveys during Moffat's regime as the reason for his resignation as president of the road. Yet the Rio Grande was then in its pioneer stage and the surveys ordered by Moffat were fully justified by the necessity of securing all available data upon possible new routes before the management should proceed with extensive and costly changes in grade and alignment on the operated line, made imperative by the competition of the broad gage Midland. While the expenditures mentioned may have been a contributing cause, Moffat and the New York directors had widely divergent viewpoints. The president was quoted upon his retirement as admitting that the directors had complained of extravagance, but added that their quarrel was with Syl Smith, not with him.[114] However, the matter is of little importance now. The pertinent and significant point involved is the connoted distinction between the directors and Moffat. The former viewed with apprehension the proposed expenditure of eight to sixteen million dollars, and the consequent interruption of dividends; Moffat was willing to forego dividends for a few years, knowing that the reduction in operating costs eventually would mean more tonnage and revenue, while the reduction in distance and grade would make of the Rio Grande a transcontinental traffic gateway. Moffat never appeared to greater advantage as a man of vision who could see that upon the general development of the state depended the welfare of its individual industries. This was the strength of Harriman who spent millions in improving the roadbed and shortening distances on the Union Pacific after assuming control, transforming that system from a liability into the greatest railroad asset of the nation. Nor should the fact be overlooked that these surveys served ultimately to simplify the problem of Moffat Road engineers when the time came to launch the Denver, Northwestern & Pacific.

Interesting contributions of Moffat to the Rio Grande system were the branches built to open new mining camps. While president he added the Ouray and the Lake City branches, and their construction aided materially in the development of great mines that have helped to make romantic the mining history of Colorado. The Creede branch was built in 1891 by Moffat and Eben Smith from their private means, after the Rio Grande had refused to construct a line to the camp. Big mining operators of the early days never failed to have in their service old and experienced prospectors, whom they grubstaked with the understanding that any strike made would be shared. The more prominent mine magnates usually had several of these picturesque characters in a sort of industrial vassalage, if such a term may be used without implication that the prospector lacked freedom of action. There never was a class of western pioneers more independent than these solitary explorers, save the free trader of fur-trapping days. With patient burro, pick and gold pan, a roll of blankets and a few simple rations the prospector traveled when and where he pleased during the summer, holing-up in his permanent log cabin for the winter like a hibernating bear. The grubstake system made Tabor a multi-millionaire. Moffat followed this custom and had among the prospectors in his retinue old Jim Creede. While operating upon a Moffat grubstake Creede discovered the Holy Moses Mine, with the result that the famous silver camp that bore his name began to boom in 1891. Moffat was the first large mining operator in the field and hence secured some of the best mines in the district. Confident that a great future was in store he suggested that the Rio Grande build a branch from its line at Wagon Wheel Gap. The request was denied and the incident gave rise to a saying that became characteristic of the banker.

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[114] *Rocky Mountain News*, October 26, 1891. Interview with David H. Moffat.

"Very well," said Moffat, "I'll build it myself." Accordingly, he and Eben Smith constructed the Creede line, about ten miles in length, to furnish transportation for the Amethyst Mine. This proved to be the greatest producer in the region. Moffat also had interests in the Bachelor and Commodore, two other producers of merit. The Rio Grande later took over the Creede line, now a part of its system.

Cripple Creek also was discovered in 1891. Moffat and Smith secured the Victor, the Golden Cycle and the Anaconda Mines here, but, as in the case of Creede, were confronted with the problem of overcoming expensive and inadequate wagon freightage. Again Moffat appealed to the Rio Grande and again met refusal.

"I'll build it myself," he repeated, and the Florence & Cripple Creek Railroad, connecting with the Rio Grande at the town of Florence, was the result. This road reached the camp a full year before the Midland Terminal and benefited accordingly. Branches were constructed to all the large mines of the district, so that the Florence & Cripple Creek became a small railroad system of considerable importance, and proved to be a very lucrative investment in itself. Moffat was the sole owner. He also owned in their entirety the Bank of Victor and the Cripple Creek State Bank, both of which he placed under the management of A. A. Rollestone. A new process in ore treatment—known as the cyanide process—had just been invented by Phillip Argall, one of the most famous mining engineers and metallurgists that the state has had. Moffat and Smith were the first to utilize the process, and Argall built for them the Metallic Extraction Mine at Cyanide, Colorado.[115] All of Moffat's Cripple Creek investments were very profitable and it was there that the bulk of his fortune was made. The Victor Mine is said to have been purchased by the partners for twenty-five thousand dollars, and to have yielded them in four years, seven hundred fifty thousand dollars.[116]

A typical example of Moffat's method in handling men occurred during the early period of Florence & Cripple Creek operation. At first the road had been mishandled and Moffat determined upon a change in management. He induced Syl Smith to return to Colorado as its president. To fill the important post of general manager he selected A. C. Ridgway, then a young man upon the threshhold of a successful career as railroad builder and executive. Prior to actual transfer of authority a party of officials was taken upon a tour of the system and, as the inspection trip ended, Moffat turned to Ridgway with the words: "You are now in control of this railroad. Everyone will respect your orders absolutely, the president of the road as well as myself—and you will be held wholly responsible for the results."[117] The Florence & Cripple Creek, which had been earning thirty thousand dollars a month, soon showed an average monthly revenue of one hundred twenty thousand dollars, and an operating

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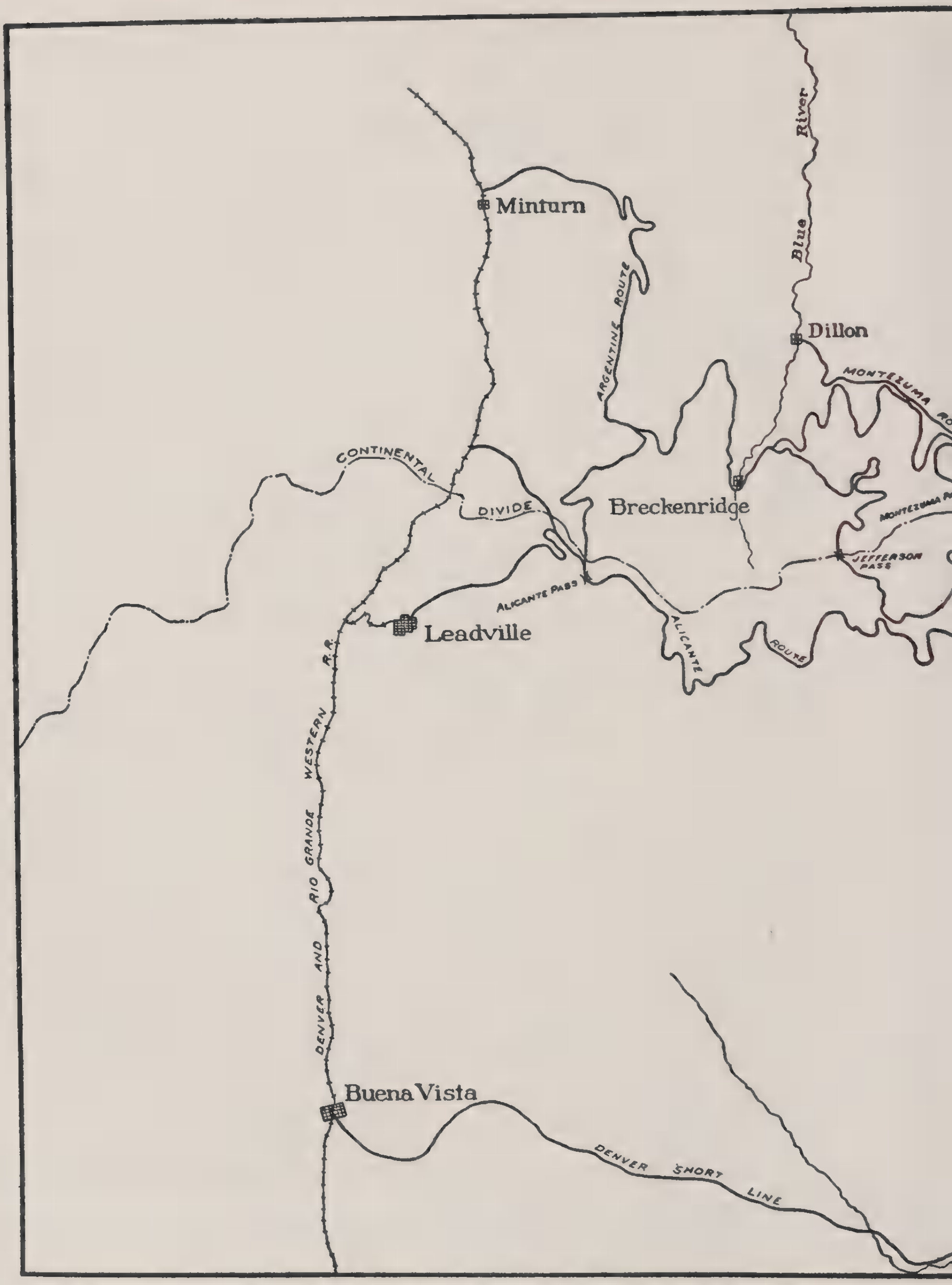
[115] The writer is indebted for valuable information in connection with Moffat's Cripple Creek operations to A. A. Rollestone of Denver.

[116] *Rocky Mountain News*, March 29, 1914.

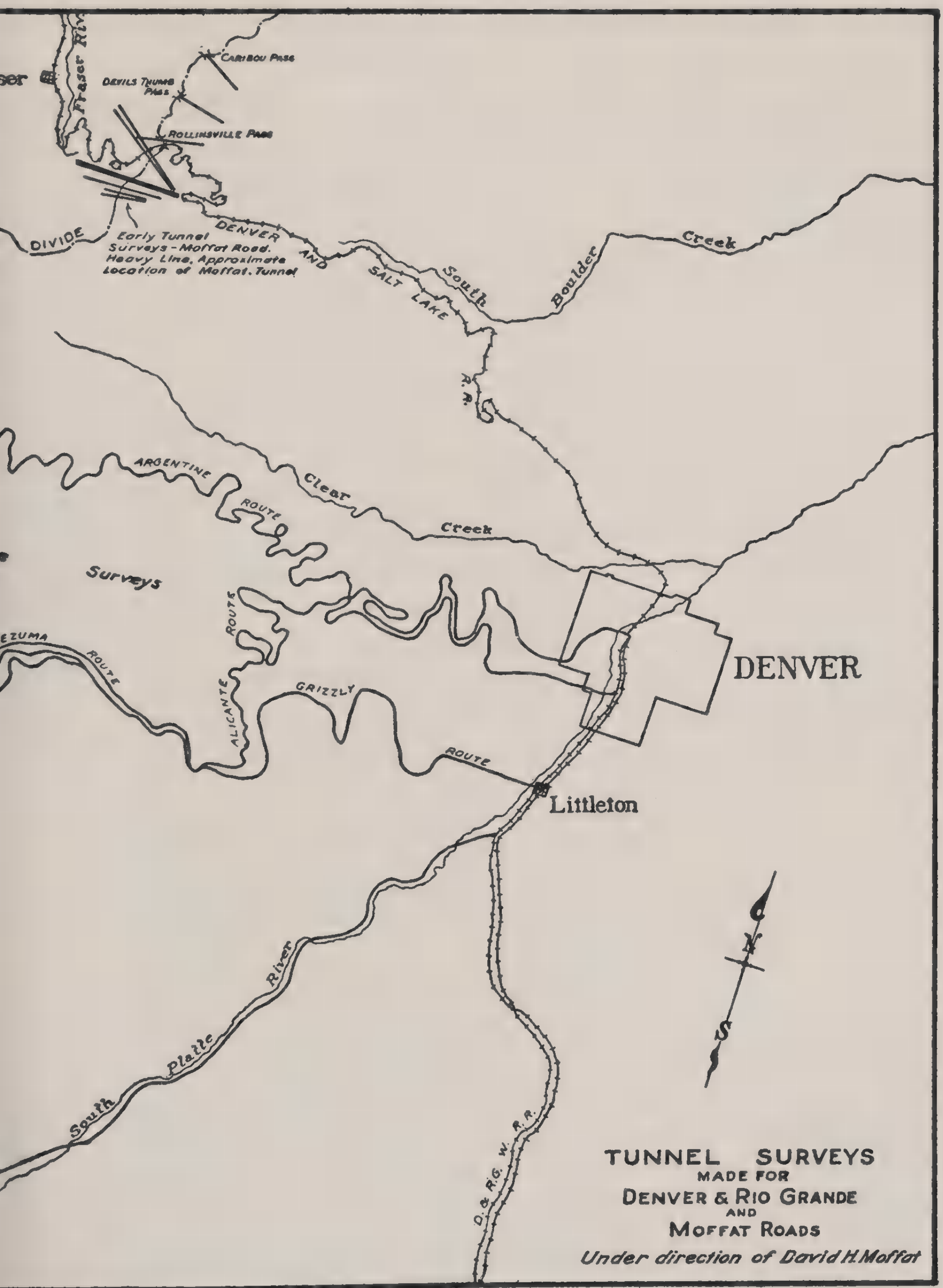
[117] This information was furnished the writer by A. C. Ridgway, who is not to be confused with his brother, Arthur Ridgway, quoted repeatedly in this work.

MAP SHOWING MOFFAT'S THORO SEARCH OF THE CONTIN



WHILE PRESIDENT OF THE RIO GRANDE DAVID H. MOFFAT CAUSED FIVE HIGH PASSES TO BE SURVEYED SOUTH OF JAMES PEAK TO LOCATE, IF POSSIBLE, A FEASIBLE TRANSCONTINENTAL PASSAGEWAY THRU COLORADO

IDE TO DISCOVER THE SHORTEST AND BEST TUNNEL SITE



WHEN HE LAUNCHED THE MOFFAT ROAD THE RANGE NORTH OF JAMES PEAK WAS SUBJECTED TO AN EQUALLY THORO COMBING, AND ROLLINS PASS FINALLY WAS SELECTED BY ENGINEERS AS THE BEST POINT cost of forty per cent of the gross return. Later, Moffat sold this railroad for three million, one hundred thousand dollars.[118]

Thruout the most productive period of Colorado mining history, a theory, amounting almost to a strict interdict, held that bankers must not engage in mining operations, because mining was classed among the speculative industries. Yet there were many well-known bankers who, while disparaging such investments to their associates and the customers of the bank, were heavily involved in mines—under the rose.

Among Moffat's most engaging traits was his unfailing scorn of any kind of deception and, as president of one of the state's strongest and most important banks, he carried on his mining operations in the open, and was known as one of the half-dozen largest mining operators in Colorado. A product of the frontier, that unmatched developer of broad-minded, forceful, independent characters, Moffat belonged to a type of banker that has almost passed out of existence. He counted human values as part of his banking assets and, while his losses probably were higher in the aggregate than those of the more prevailing type, his gains were correspondingly greater. Moffat was the sole representative of the old school during the Cripple Creek days of which we write.

One who was intimately associated with Moffat in the banking business ascribes the latter's success with the First National to his keen judgment of men. He had so developed the faculty of organization that he could select and place men at the heads of his various enterprises, yet maintain complete knowledge of progress thru a system of reports centering upon him. Those in charge of his operations were given utmost authority, but Moffat insisted upon facts and figures as well as opinions in these reports, so that he could form his independent judgment. Above all, he wanted the truth and those who knew him best never hesitated to tell him anything. A mistake in a subordinate was not fatal. The banker did not expect perfection. He was broad in his views, very kind and just, and these were the qualities that kept men loyal to his enterprises, to himself and to his memory after death.

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[118] Idem. Also see *Denver Republican*, March 19, 1911.

The decline in silver, which began in 1891, reacted disastrously upon Colorado; indeed, as the largest silver producing state in the Union, Colorado suffered more than any other section.[119] From the year 1890, when silver stood at one dollar, five cents an ounce, the price dropped to sixty-three cents in 1904.[120] The crisis arrived in 1893, when twelve Denver banks closed their doors within three days. Real estate values crashed overnight, thousands lost their homes, men who had been affluent were pauperized in a day; the unemployed became so numerous that relief camps were opened on the outskirts of the city.

Thruout this tremendous debacle Moffat played an heroic part and it was his boast that no customer of the First National went under during the panic. Two million dollars worth of gold securities—his personal property—were liquidated by him and the proceeds deposited in the First National Bank to meet the emergency.[121]

During that hysterical period, when lines of frightened depositors stood before the door of every bank, Frank Avery, President of the First National Bank of Fort Collins, becoming uneasy in the face of general disaster, called upon Moffat. He carried in his hand an ordinary leather grip, which he placed upon the floor at his feet.

"I have not done business with your bank, Mr. Moffat," he said, "but I may need your help. I would like to know whether I can depend upon you and, in order that you may know our condition, I have brought these securities." He started to open the grip, filled with gilt-edged securities. Moffat halted him with a gesture.

"I know your bank," he said. "Go back to Fort Collins and if you need help—telegraph. I will send you a telegram in reply stating that the First National Bank of Fort Collins will never go under until the First National Bank of Denver does."[122] It was the pioneer banker who spoke thus; for the pioneers, by force of circumstances, were compelled to depend upon and trust one another, and they acquired an insight into mens' characters otherwise impossible to attain.

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[119] Colorado then was producing fifty-eight per cent of the total silver mined in the United States. *History of Colorado*, Swan and Herrick on "Banking," 890.

[120] Henderson, *op. cit.*, 541.

[121] Hill, *op. cit.*, 298. See also *Rocky Mountain News*, March 29, 1914.

[122] *Denver Republican*, March 19, 1911. Quotes the late A. M. Stevenson, Denver attorney. Also *Rocky Mountain News*, October 10, 1902. Reprint from *Cosmopolitan Magazine*. Hill, *op. cit.*, 298.

The period immediately preceding and extending thru the panic saw the modernization and extension of two important public utilities, the Denver Union Water Company and the Denver Tramway Company, in both of which Moffat was interested. Construction of the first water plant began in 1870, but eleven companies had been engaged in supplying the city between that date and their absorption by the Denver Union Water Company. James Archer, Jerome B. Chaffee, E. F. Hallack, George W. Clayton, Walter S. Cheesman, Daniel Witter, David H. Moffat and others were founders of the parent organization. In 1890 the company began construction of the Cheesman Dam, two hundred thirty-six feet high, with a capacity of twenty-six billion gallons.[123] The work proceeded steadily thru the panic, altho it was necessary to haul materials twenty-three miles by wagon. The dam was completed in 1895. In 1914 the City and County of Denver acquired the entire holdings.

The major part of the Tramway system also was built during the nineties. The parent company, which later absorbed all competing lines, was organized in 1885 by Rodney Curtis and William G. Evans, son of the governor, but it was the latter, Moffat and other moneyed men of the time, who furnished the capital.

These utilities both are bound inseparably with the history of the Moffat Tunnel, since the Municipal Water Plant will receive its augmented supply from the Western Slope directly thru the tunnel, and the Tramway company, in one sense, was parent of the giant bore. When the Denver, Northwestern & Pacific was organized Moffat was one-half owner of the Tramway and his interest in that corporation is represented in the Moffat Road. Furthermore, the Moffat Road was conceived as an electric feeder system for the Denver Tramway, to serve Northwestern Colorado and Middle Park.

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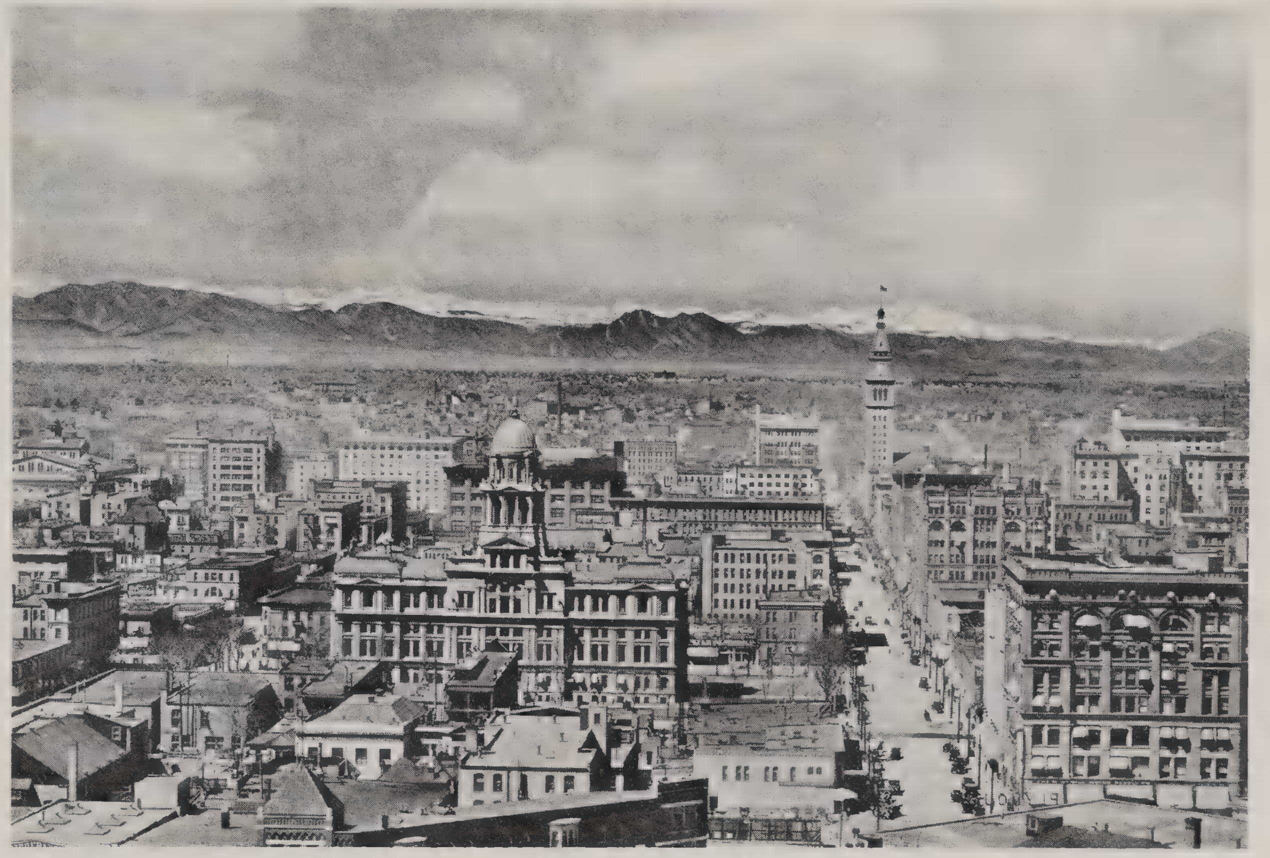
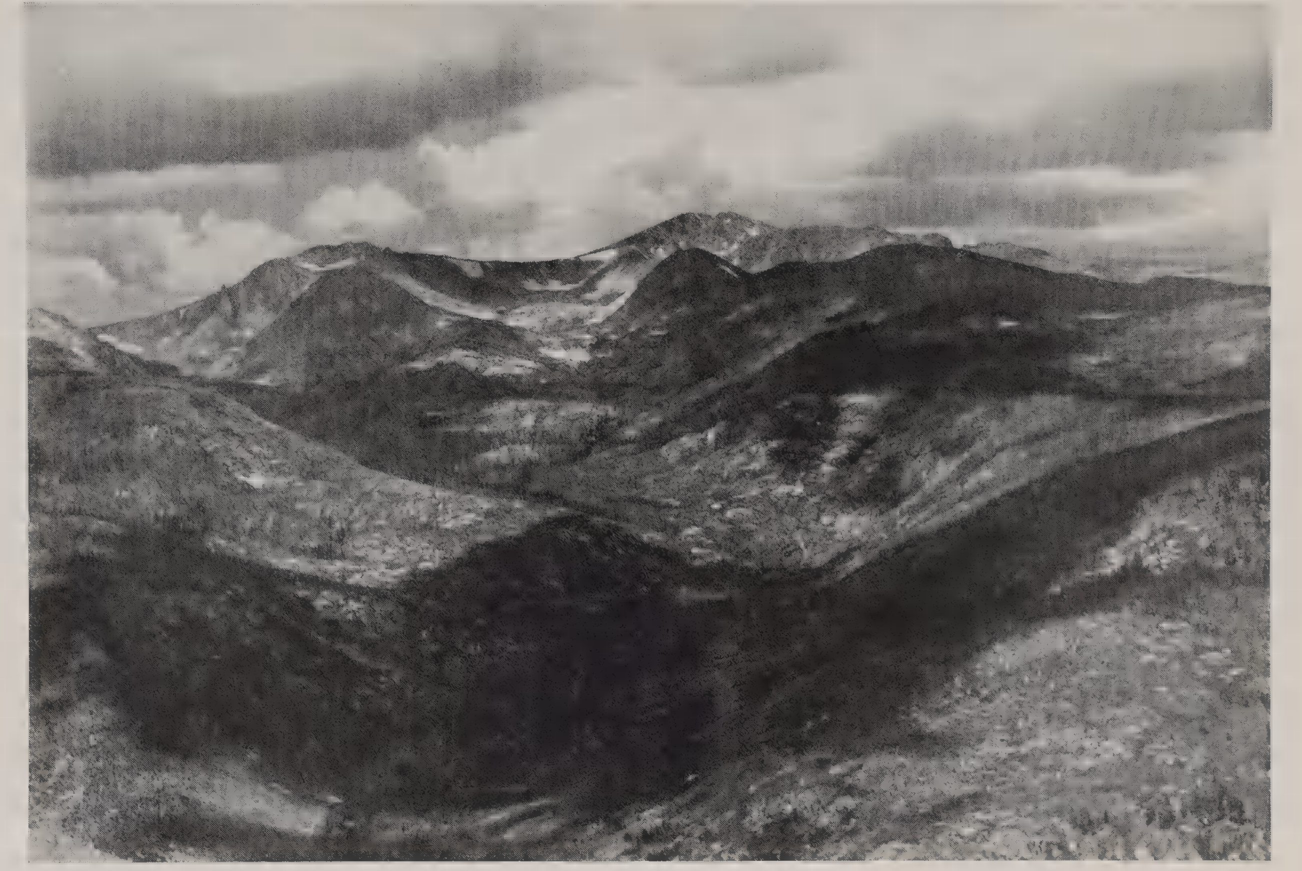
[123] Historical Pamphlet of the Denver Union Water Company and the South Platte Canal & Reservoir Company.



CONTINENTAL DIVIDE, THE GREAT BARRIER TO TRANSCONTINENTAL TRANSPORTATION THRU COLORADO: DENVER, 1912
(*Page 13*)

JAMES PEAK AND FLANKING RANGE ON THE NORTH THAT RAILROADS HAVE SOUGHT TO PENETRATE FOR SIXTY YEARS
(Page 51)



DEVILS THUMB PASS (LEFT), WHERE MOFFAT ROAD ENGINEERS MADE AN UNSUCCESSFUL SURVEY IN THE YEAR 1901
(Page 109)

ONE OF THE FIRST MIDDLE PARK RANCHES, ONCE A FAMOUS STAGE STATION

TRANSPORTATION IN MIDDLE PARK BEFORE THE RAILS CROSSED THE RANGE

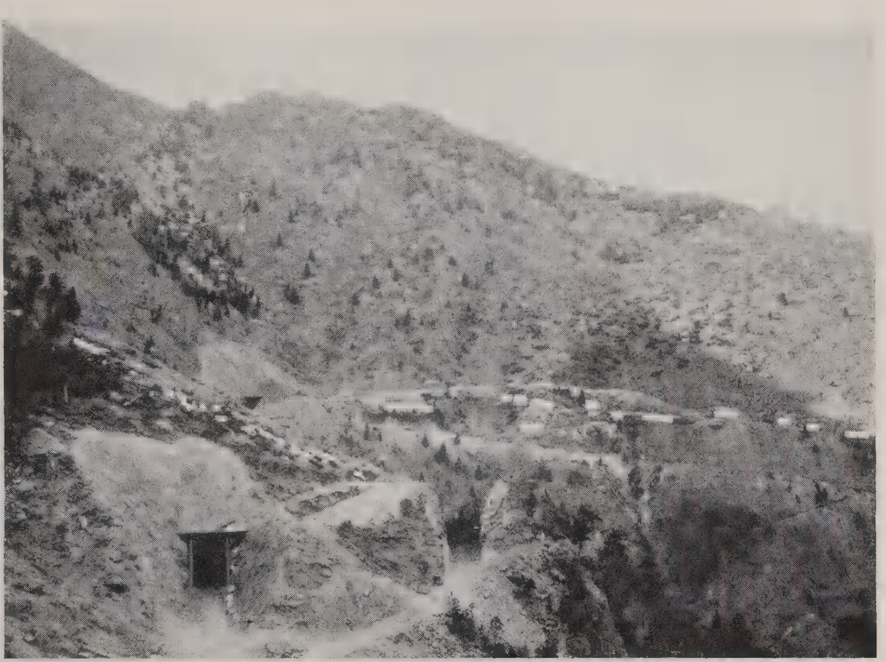
MOFFAT ROAD SURVEYORS BREAKING ROAD THRU BERTHOUD PASS IN WINTER.

ONE OF THE PIONEER SURVEYING PARTIES ON LOCATION—WINTER OF 1912.

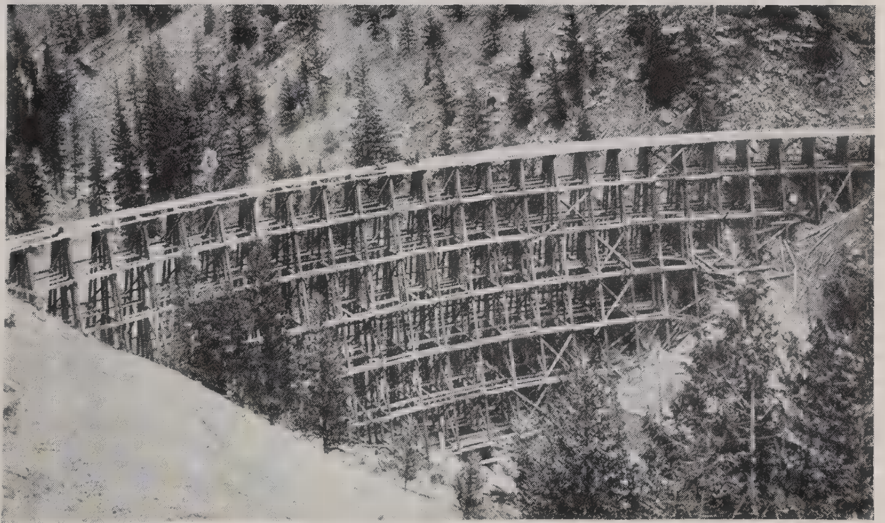
ENGINEERING DIFFICULTIES ON BOULDER CANON LOCATION
(Page 109)

SURVEYORS' LOG SUSPENSION BRIDGE—USED DURING GORE CANON SURVEY
(Page 118)

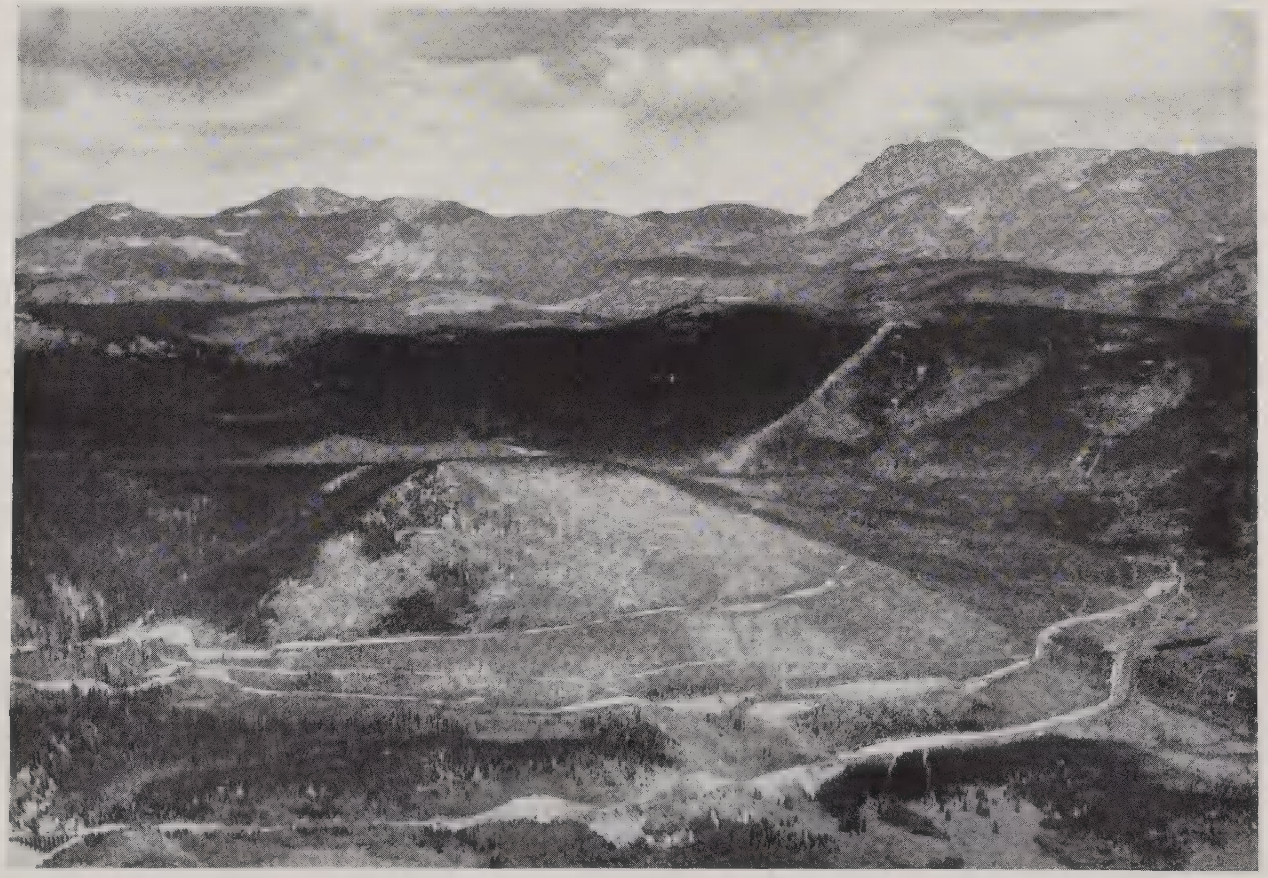
ENGINEERS OF THE MOFFAT ROAD LOCATING ON GREEN RIVER IN 1904



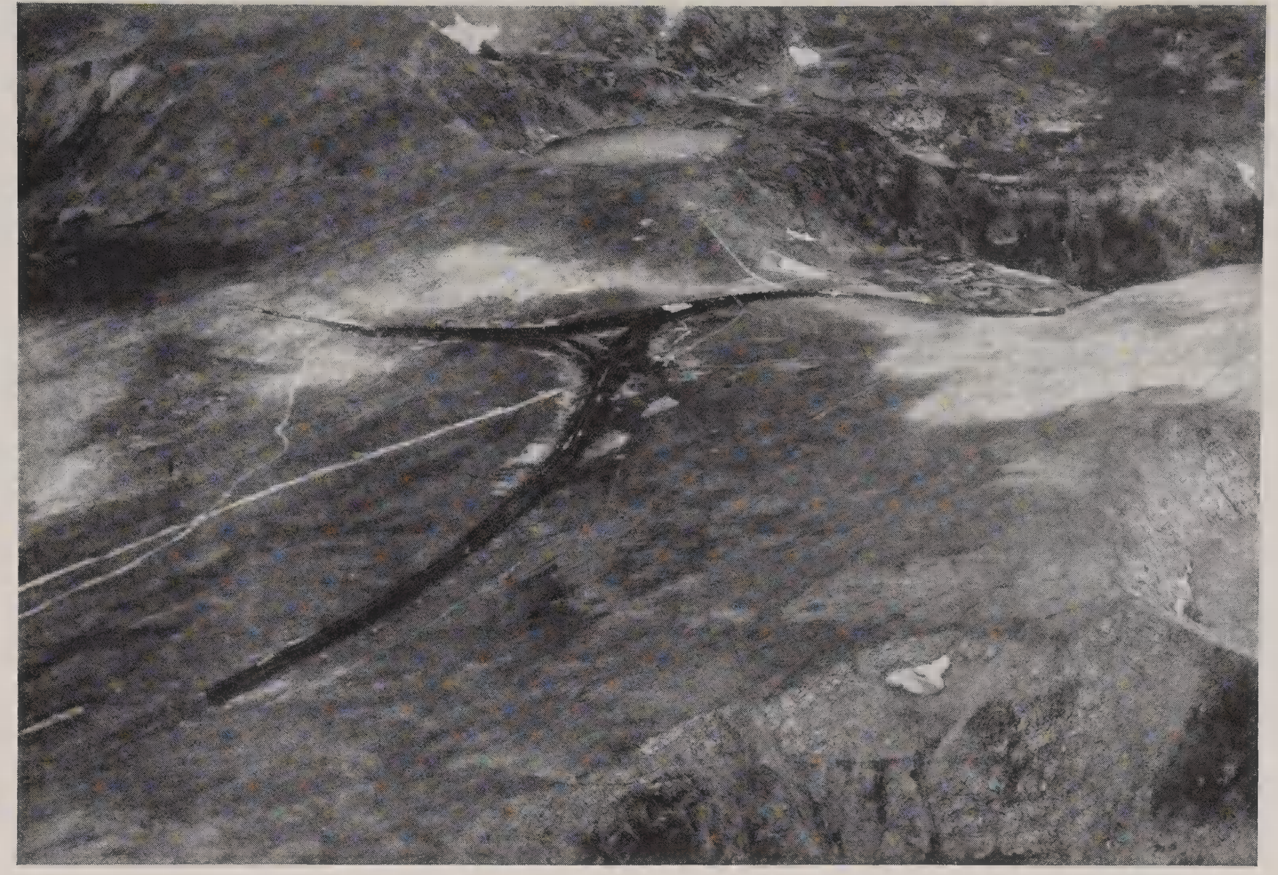
ONE OF THE HITCHCOCK & TINKLER CAMPS ON THE MOFFAT ROAD IN 1904



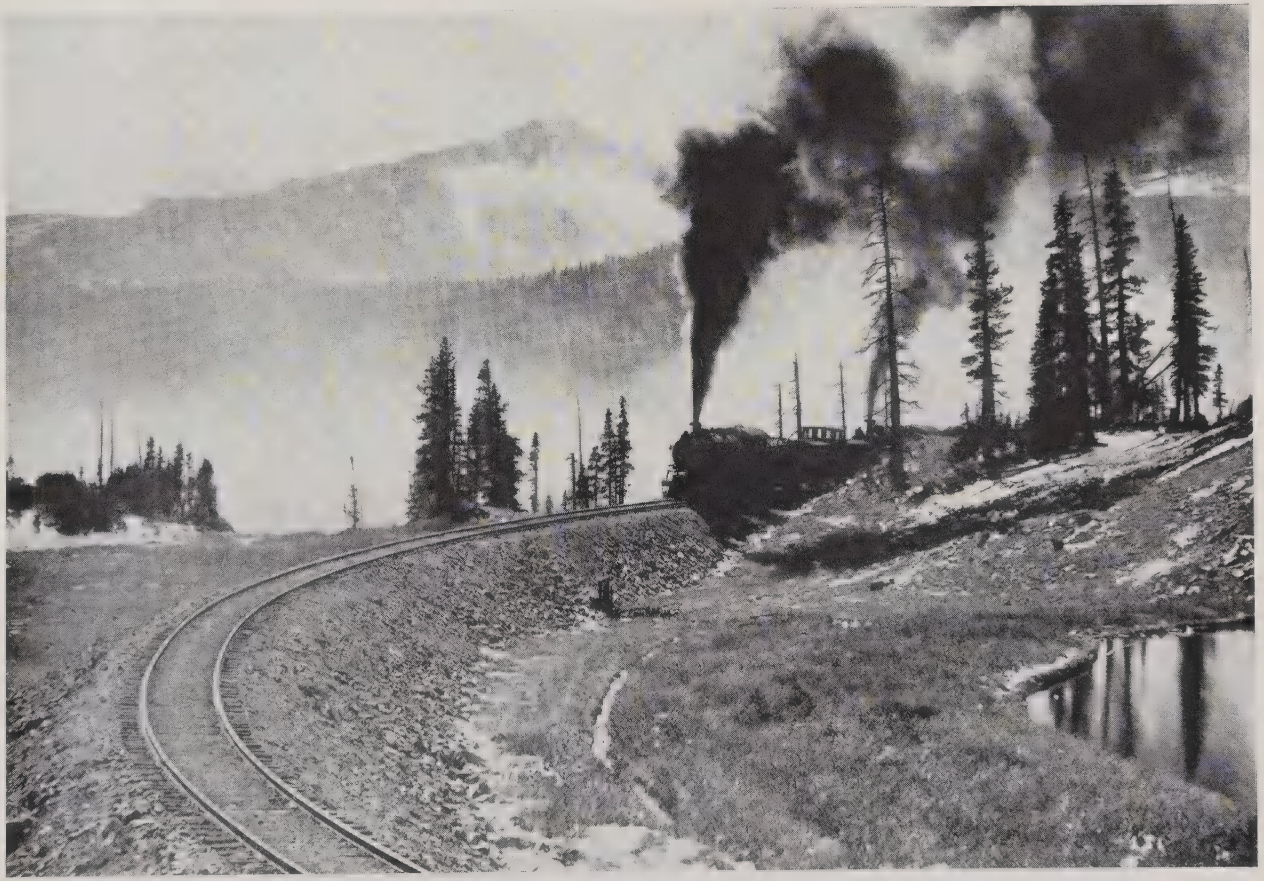
HEAVY CONSTRUCTION ENCOUNTERED IN ROCK CREEK, WEST OF GORE CANON



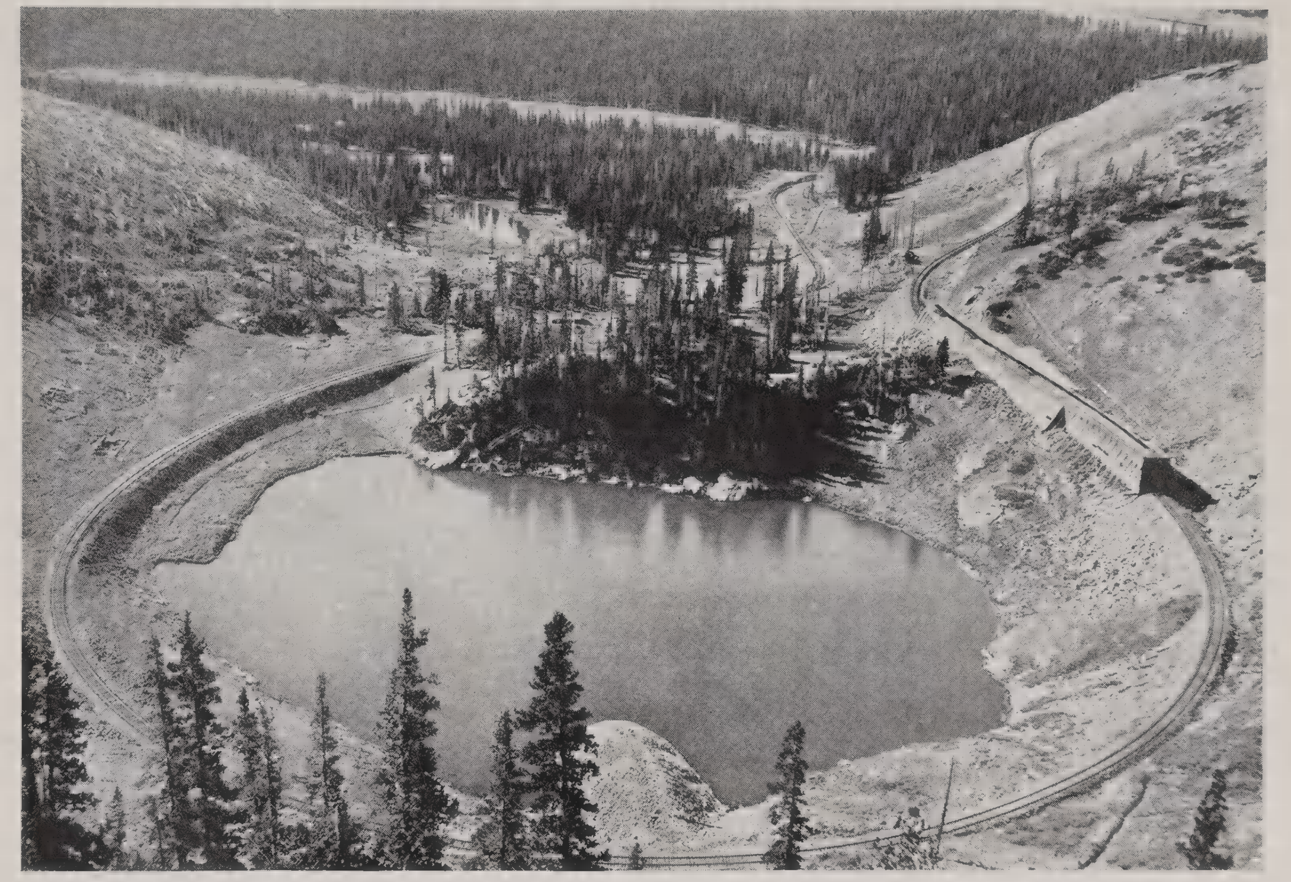
GIANT'S LADDER ABOVE TOLLAND, WHERE FOUR PER CENT GRADES "OVER THE HILL" BEGIN ON THE MOFFAT RAILROAD



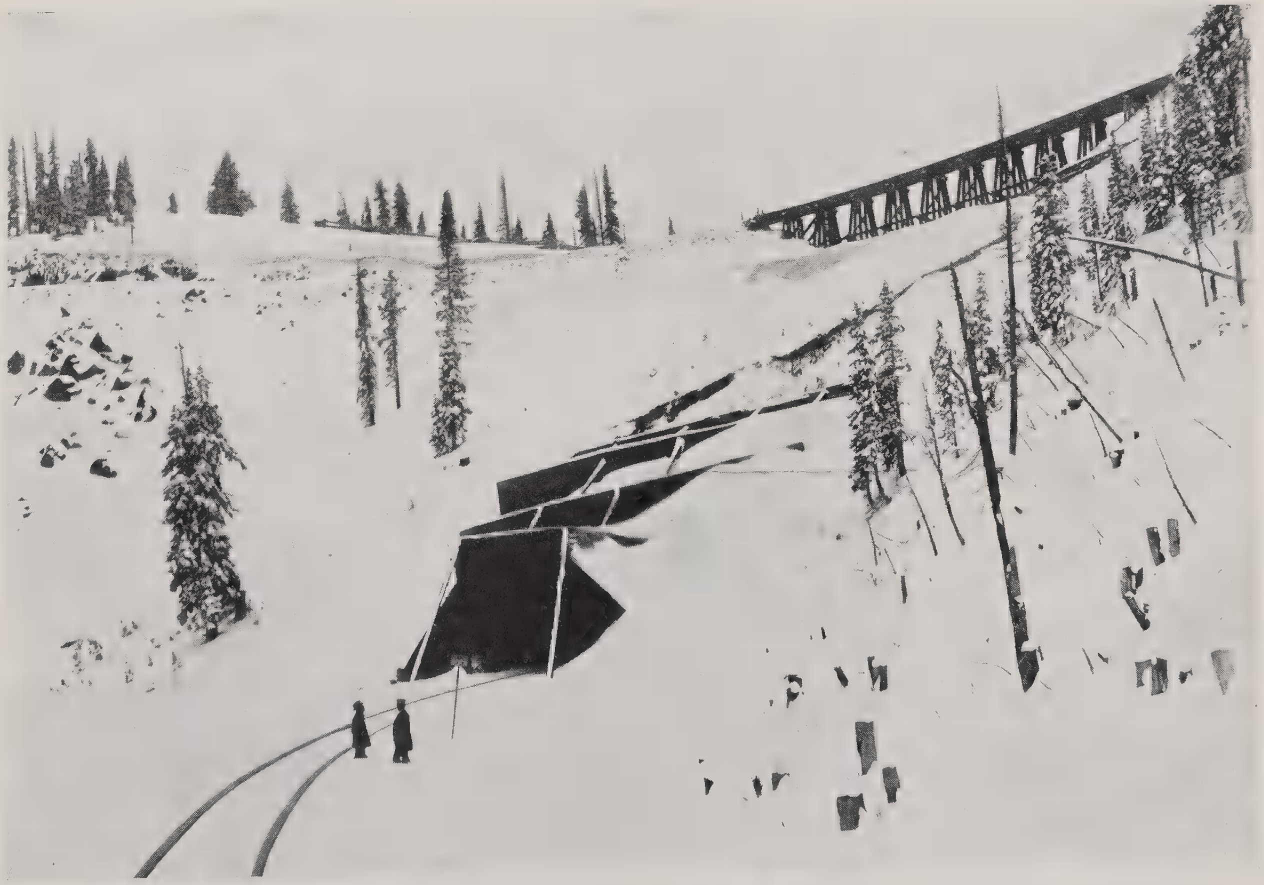
AIRPLANE PHOTO OF ROLLINS PASS AND CORONA SNOWSHEDS—ELEVATION ELEVEN THOUSAND, SIX HUNDRED SIXTY FEET
(*Page 116*)



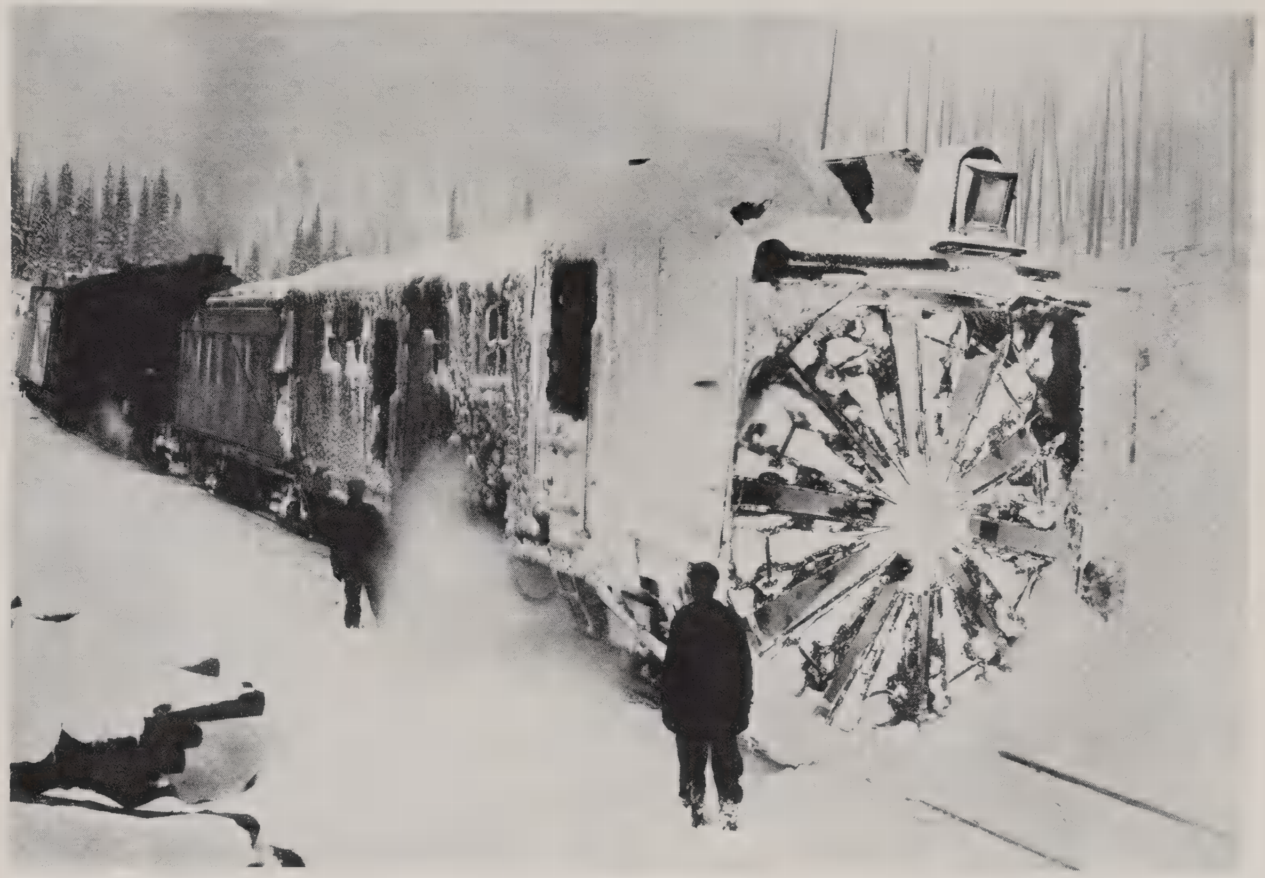
A DOUBLE-HEADER ON THE FOUR PER CENT GRADE BETWEEN TOLLAND AND CORONA. JAMES PEAK IN THE DISTANCE



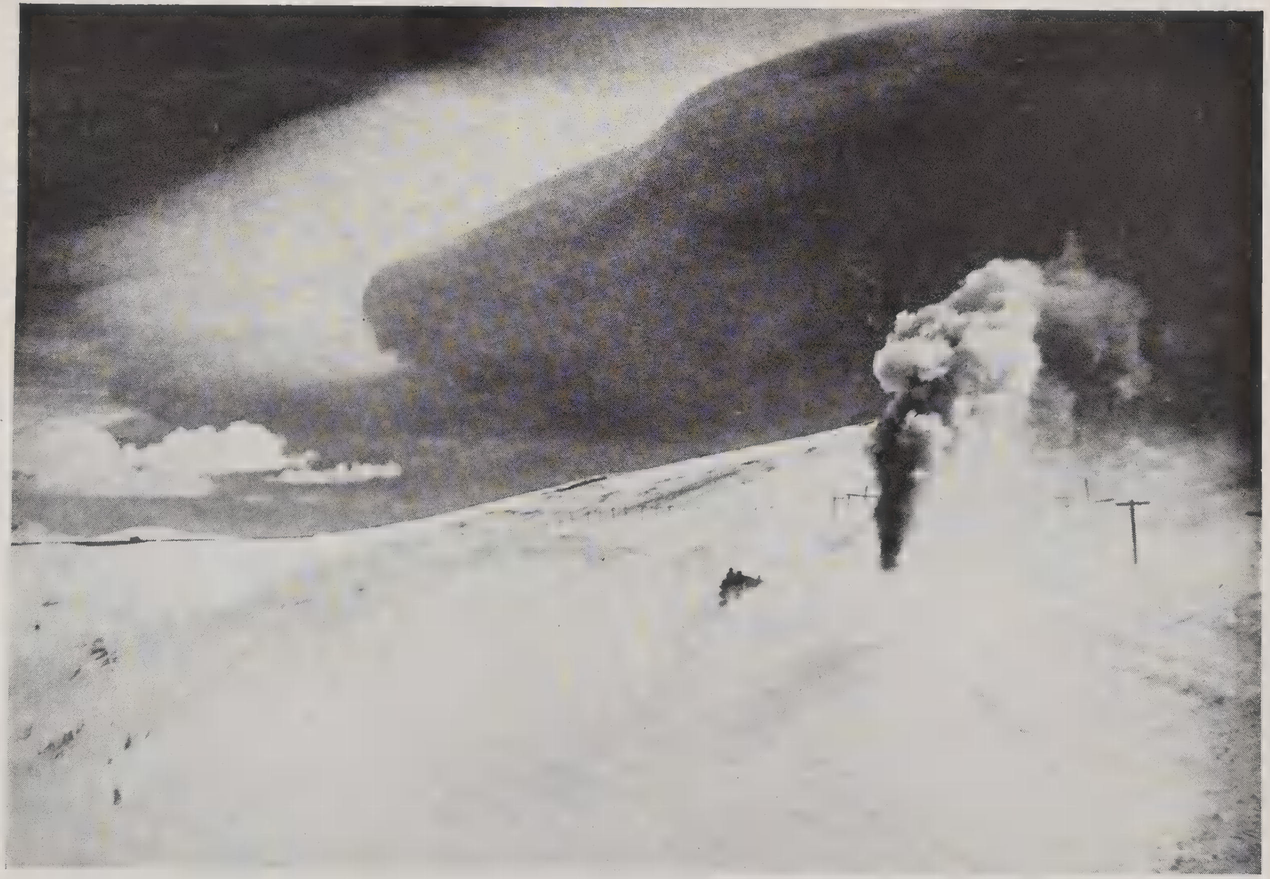
CIRCLE OF STEEL AROUND YANKEE DOODLE LAKE. THE OLD DUMP OF THE DENVER, UTAH & PACIFIC IN THE LAKE
(Page 69)



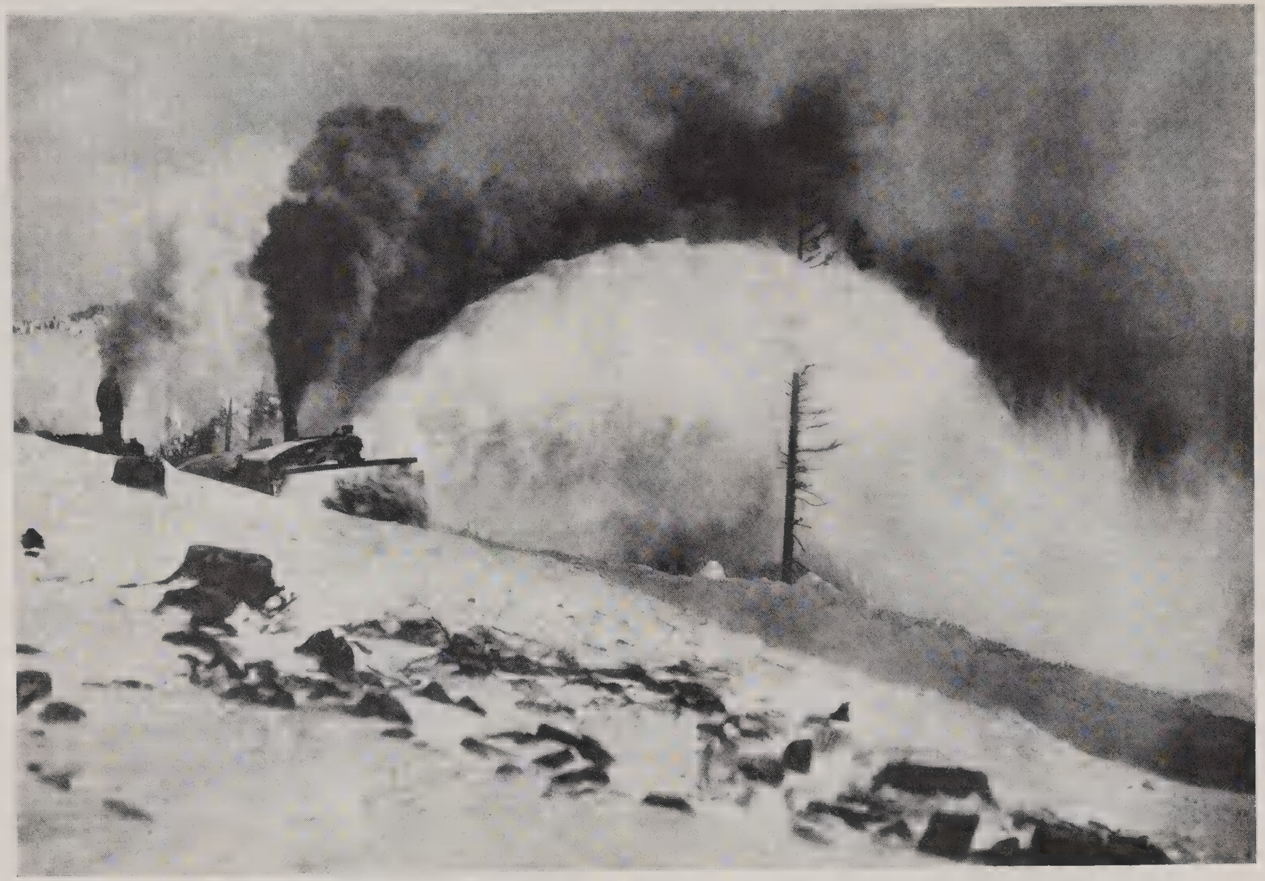
RIFLE SIGHT NOTCH ON THE WEST SIDE OF THE DIVIDE WHERE THE MOFFAT ROAD TRACKS MAKE A COMPLETE CIRCLE



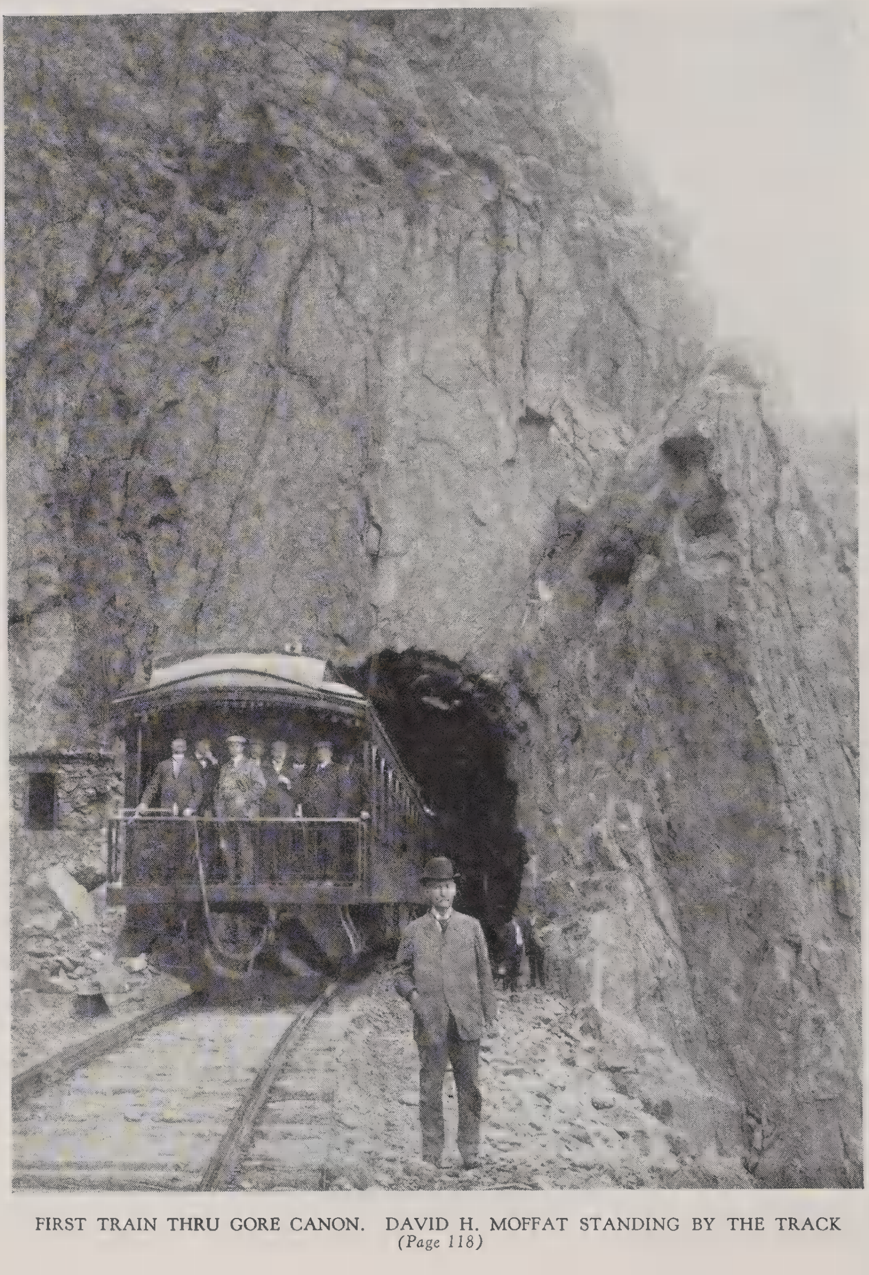
FORTY-ONE PER CENT OF OPERATING COST ON THE ROAD HAS BEEN ASCRIBED TO SNOW BLOCKADES ON ROLLINS PASS
(*Page 134*)



"THE PROJECTING TIP OF A SMOKE-STACK WITH ITS PLUME . . . TOLD THAT HUMAN BEINGS WERE IN THE WHITE WASTE"
(Page 117)



BLIZZARDS ROARED OVER TREELESS HEIGHTS, PACKING SNOW IN ENORMOUS DRIFTS THRU WHICH SNOW PLOWS LABORED
(Page 117)



FIRST TRAIN THRU GORE CANON. DAVID H. MOFFAT STANDING BY THE TRACK
(Page 118)

Part Two

THE RAILROAD

PART TWO.

THE RAILROAD

CHAPTER I.

THE DIVIDE A RAILROAD GRAVEYARD—OTHER INVESTMENT OPPORTUNITIES — MOFFAT'S EXTENSIVE HOLDINGS—ELECTRIC LINE SUGGESTED—MOFFAT DECIDES UPON A STEAM RAILROAD—RIDGWAY'S SELECTION—MOFFAT'S PURPOSE REVEALED—ROLLINS PASS CHOSEN—HARRIMAN'S OPPOSITION—BATTLE FOR GORE CANON—HUGHES' NOTABLE SERVICES—ROOSEVELT TAKES A HAND—CONSTRUCTION DIFFICULTIES—TRAGIC WINTER OPERATION—THE HARRIMAN-MOFFAT MEETING—THE BLACK YEAR AT YARMONY—COL. DODGE EXTENDS AID—STEAMBOAT REACHED—MOFFAT FINANCIALLY RUINED—HIS DEATH IN NEW YORK.

THE high passes over the Continental Divide between the Arkansas River and the Wyoming line were haunted by the ghosts of dead railway projects when David H. Moffat, then sixty-three years old, decided to launch the most ambitious enterprise of his life. He was not one to be intimidated by the past. For every failure he could point to many conspicuous successes in which he had been an actor. As in his banking operations, he expected in other walks of life a certain percentage of loss but a larger measure of gain. His faith in the efficacy of steam transportation was serene.

At the apex of his career, politically and financially, Moffat turned once more to the plaything that had most fascinated him in life—the railroad. He had been born about the same time that the railroad had come into being as a commercial factor, had grown up with it and, with the whole world, had stood amazed at its marvelous power of colonization. Moffat had used this agent to help amass a great fortune from the mines, to participate in the settlement of his adopted state, to develop permanent industry. Like Aladdin's magical carpet, the railroad had crossed wide rivers, spanned barren deserts, climbed towering mountains, almost in a breath. Treasure caves of silver and gold it had opened upon a thousand hills. Mythology had been modernized. A wish was expressed by the master who held the talisman—the genie of the locomotive arose in a column of black smoke—the thing desired was done! Fascinating toy of ambition! Wonderful servant of power!

During the thirty years intervening between 1870 and 1900 Moffat had watched a network of shining rails follow the trails of lonely prospectors "Where the meek and mild-eyed burros on mineral mountains feed."[124] But the high Divide west of Denver still was unshackled by man, altho some twelve to fourteen passes had been surveyed, eighteen to twenty distinct railroad projects bravely launched of which possibly one-half had involved plans for tunnels.[125] While the majority of these plans never had passed the promotion stage, several lines were partially constructed and operated. The Union Pacific alone spent over two million dollars on the Greeley, Salt Lake & Pacific, the Georgetown, Breckenridge & Leadville and the Denver & Middle Park. In two instances the Divide had been crossed north of the Arkansas—at Boreas and Fremont Passes. The amusing feature of this construction lies in the fact that the South Park built across the Range from the Atlantic to the Pacific Slope at Boreas, and recrossed to the Atlantic Slope at Fremont Pass. This extraordinary feat, as related before, was performed by the Union Pacific in a vain effort to regain its share of the Leadville business, after the voluntary relinquishment of its joint trackage rights with the Rio Grande.

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[124] From Cy Warman's poem "Creede."

[125] Nearly all of these trans-Divide projects have been mentioned, but a brief review will give the reader a better appreciation of Moffat's courage in the inauguration of the Denver, Northwestern & Pacific.

Cameron Pass, between Cache-la-Poudre River and North Park. Not a true divide crossing, but it meant the latter at either Muddy or Willow Creek Pass. Surveyed by the U. P. in 1866; Burlington in 1881; Greeley, Salt Lake & Pacific (U. P. subsidiary) in 1881. This route was partially graded in the canon and operated from Greeley to Fort Collins. It was undertaken by the U. P. to prevent the Burlington from using Cameron Pass and abandoned when the locomotive engineers' strike in 1887 caused the Burlington to abandon its trans-Divide plans in Colorado.

Boulder, or Rollins Pass, between South Boulder Creek and Middle Park. Gilpin, Jefferson & Boulder County Railroad and Wagon Road (A. N. Rogers' line) in 1867; U. P. in 1866; Kansas Pacific in 1869; Colorado Railroad (B. & M. subsidiary) in 1884—two tunnels located; Denver, Utah & Pacific in 1881 (construction started and tunnel located).

Berthoud Pass, between Clear Creek and Middle Park. E. L. Berthoud survey in 1861; F. M. Case survey in 1861 (tunnel suggested); U. P. in 1866 (tunnel located); Denver, Georgetown & Utah, 1871; Denver & Middle Park in 1883 (U. P. subsidiary, partly constructed); Colorado Central (number of surveys not known).

Loveland Pass, between Georgetown and Blue River. Denver, Breckenridge & Leadville in 1881 (U. P. subsidiary). This road built the famous Georgetown Loop: Denver & Transcontinental in 1906. This was the shortest and best survey ever made between Denver and Minturn, south of Rollins Pass. Made by H. M. Rogers, at one time chief engineer of the Rio Grande, for Rees C. Vidler and associates. The line passed over Lookout Mountain and followed Clear Creek in a general way, crossing the Evans group of mountains at Echo Lake.

Argentine Pass, between South Fork of Clear Creek and Blue River. Denver & California Short Line in 1882 (tunnel involved); Atlantic & Pacific Tunnel in 1884; Denver & Rio Grande in 1889 (a Moffat survey).

Georgia (or Jefferson) Pass, Grizzly and Montezuma Passes, between South Park and Blue River. Denver & Rio Grande, 1889-1891. Moffat surveys.

Alicante Pass in the Park Range. Rio Grande about 1890. Moffat survey.

Boreas Pass, between South Park and Blue River. Crossed by South Park, 1882.

Hoosier Pass, between South Park and Blue River. Denver & Salt Lake Railway in 1871. Incorporated by W. N. Byers, Gov. A. C. Hunt and others (Doc. 649, Book D-402, Secretary of State).

Fremont Pass, between the Arkansas and Blue Rivers. Crossed by South Park and Rio Grande.

In addition to these, incorporation papers of the Denver, Utah & Pacific state that its line would cross the Divide at Cache-la-Poudre (Cameron), Big Thompson, St. Vrain or Boulder passes, the implication being that surveys were made at all these points. Doubtless there were many other surveys of which the records are unobtainable, but the summary will give sufficient idea of the potency of the pioneers' dream of a transcontinental route. We will list the Moffat Road surveys later.

If we include in the cost of these operations the Colorado Central, built by Loveland with the predominant idea that it was to be the gateway for a transcontinental carrier (but exclude the South Park entirely) enough money was spent to have constructed the Moffat Tunnel.[126]

Moffat was perfectly familiar with this closet of railroad skeletons and had played the mourner's part at the obsequies of several. From a personal investment standpoint there was every reason on his part against further battle with the great barrier, for it had become apparent that the struggle would be long and costly. Two national railroad systems had recoiled before the magnitude of the task. In the days of which we write, before modern tunneling methods and power machinery had been brought to their present state of perfection, a half-mile bore would have been almost as serious as a six-mile tunnel today. Each snow-clad, austere peak on the western horizon, soaring aloft as mens' ambitions climb, was the tombstone of some brave enterprise, some bright hope of empire. But Moffat no longer was the man whose stake had been set at seventy-five thousand dollars, whose idea of perfect enjoyment was a quiet home in New York state. While he was in New York, just before public announcement of the Moffat Road plan was made, a former Colorado mining man, then engaged in the promotion business in the East, called upon him at the Fifth Avenue Hotel in order to interest the banker in a valu-

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126. The *Report of the Railroad Commissioner for Colorado*, 1885, gives the cost of Colorado Central construction as $10,708,380.14 (321); Georgetown, Breckenridge & Leadville, $428,380.81 (434); Denver & Middle Park, $29,720.90 (14); Greeley, Salt Lake & Pacific surveys and grading in Poudre Canon cost $100,000 (Watrous, *History of Laramie County* (244). Construction of this road cost $1,616,500. See *Report of the Railroad Commissioner for Colorado*, 413-433. Construction of the Colorado Railroad and the Denver, Utah & Pacific each are reported to have cost $500,000 (*Denver Republican*, October 2, 1904). Moffat's Rio Grande surveys, $106,374.15 (Ridgway *op. cit.* 848.)

able West Virginia coal property. Moffat's negative reply contained a prophetic note: "When I was a young fellow I went to Colorado—walking over the dusty plains with very little cash in my possession. Denver was a struggling village and I began in a very humble way to make my living. All I possess in the world today I made out there in those hills and there is where it will all remain and be spent by me—for the welfare of Colorado."[127] Moffat had helped to weave the fabric of a commonwealth and, in so doing, had woven himself into the warp and woof. The Continental Divide offered no obstacle to his vision.

There were many new and attractive opportunities for investment at this period had that been Moffat's object. Mining was then at its zenith, and he was already heavily involved. Nineteen hundred was the peak year for metal production in Colorado, the output that year exceeding fifty million dollars. Nearly twenty-nine millions in gold alone had been mined, chiefly from Cripple Creek.[128] Two of Colorado's greatest manufacturing industries had just been started. The erection of a beet sugar plant in Grand Junction had been followed in 1900 by organization in Denver of the Great Western Sugar Company by Charles Boettcher and associates. This had resulted in construction of plants at Longmont, Greeley, Eaton, Windsor and Fort Collins within a three-year period.[129] The cement industry, born with the Geddes & Seerie plant in 1899, had been taken over in 1891 by the Portland Cement, later to become the Colorado Portland Company, also controlled by Boettcher and associates.[130]

Moffat, however, had no occasion to seek new fields for investment. Just before he launched the Moffat Road he one day showed to A. A. Rollestone, his bank manager at Victor and Cripple Creek, personal credits on New York banks for seven million dollars.

"If I had that much money," said Rollestone, after taking a long breath, "I would not build railroads or do anything more in my life."

"Well," replied Moffat, "I am not satisfied to do nothing. I want to be doing something new—I want to be building or developing some enterprise. I get my pleasure that way."

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[127] Letter of W. M. McMechen, Sr., to the writer, dated October 27, 1924.

[128] Henderson, *op. cit.*, 543. Total production of metals 1900, was $50,614,424.

[129] Shepard on "Industrial Development in Colorado." *History of Colorado*, 735.

[130] Idem. 743.

Moffat then owned seventy-five per cent of the First National Bank stock, the banks of Cripple Creek, Victor and Hot Sulphur Springs; mining properties in Cripple Creek, Leadville and the San Juan; was interested in the National Bank of Commerce and the Equitable Life of New York; the International Trust Company of Denver, Denver Union Water Company and owned one-half the Denver Tramway.[131] While he did not actively engage in politics, his influence in the Republican party was very potent, and he was always a large contributor to campaign funds.

We have mentioned before the close connection between the Moffat Road and the Tramway Company. William G. Evans, then president of this corporation, broached a plan to Moffat for extension of the electric system over the Continental Divide to Hot Sulphur Springs.[132] The latter gave his consent to the proposal and, on June 6, 1901, the Denver & Northwestern Railway was incorporated by Samuel M. Perry, William G. Smith, Francis A. Perry, Charles J. Hughes, Jr., Gerald Hughes, Clyde Turnbull and Albert Smith. Lines were projected from Denver to Greeley, Louisville, Boulder, Golden and Littleton. The capitalization was two million, five hundred thousand dollars, but no mention was made as yet of the trans-Divide project.[133]

Not alone was the Tramway to become an interurban passenger system, but it was to tap the coal fields of Boulder County and supply the Denver market. Three of the incorporators were new to Colorado railroad history, but they were destined to play leading roles in the building of the Moffat Road. These men were: Charles J. Hughes, Jr., later United States senator from Colorado and one of the greatest trial lawyers and authorities on mining law that the West has produced; his son, Gerald Hughes, then just from college, who drew the first incorporation papers; and Samuel M. Perry, secretary of the

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[131] *Denver Republican*, March 19, 1911.
[132] *Municipal Facts*, Vol. VI, Nos 8 and 9.
[133] Book 90, page 5, Records of the Secretary of State.

Moffat Road and one of Moffat's most faithful supporters. Early in the spring of 1902 William G. Smith, vice-president of the Tramway, announced that construction would start immediately upon a line from Arvada to the coal fields of Leyden, where the company had acquired one hundred sixty acres of land.[134]

The incorporation papers were amended April 3, 1902, this amendment containing provision for an electric line from Denver by way of Coal Creek Canon to South Boulder; thence to Rollinsville, over the Continental Divide via Rollins Pass to Fraser River; thence across Middle Park to Hot Sulphur Springs. Branches were to be constructed to smaller towns, including one line to the Grand Lake summer resort. Power houses and plants, overhead and feed wires were mentioned. The capitalization was raised to six million dollars.[135]

Evans and Gerald Hughes departed immediately after this for New York, where they hoped to finance the project. They had made considerable progress and were sanguine of success when, like a bolt from the blue, came the cryptic message from Moffat: "I have decided to build a steam railroad from Denver to Salt Lake City."[136] Moffat himself then went to New York and soon had completed arrangements whereby a group of Providence capitalists, headed by Marsden L. Perry, and a wealthy Holland family, by name of Boissevain, agreed to back the road. Upon his return to Denver the banker announced that the proposed steam road would connect with the Clark Road to the Coast; that its estimated cost was sixteen million dollars, plus four millions for tunnels and terminals.[137] In so far as his estimate of the railroad was concerned Moffat was close to the mark. He had no intention to build a six-mile tunnel then, but had planned a two and one-half mile tunnel.

The Denver, Northwestern & Pacific Railroad, first official name of the Moffat Road, was incorporated July 18, 1902, with a capital stock of twenty million dollars. Moffat's name appeared officially for the first time in this document, the list of incorporators being

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[134] *Denver Republican*, February 21, 1902.
[135] Book 90, page 593, Records of the Secretary of State.
[136] *Municipal Facts*, Vol. VI, Nos. 8 and 9.
[137] *Rocky Mountain News*, March 22, 1902. Quotes D. H. Moffat.

David H. Moffat, Walter S. Cheesman, William G. Evans,, Charles J. Hughes, Jr., George E. Ross-Lewin, S. M. Perry and Frank P. Gibson. First mortgage bonds were authorized in a total amount of twenty-two million, five hundred thousand dollars and the announcement was made that a tunnel to cost one million, five hundred thousand dollars would be constructed. The Colorado-Utah Construction Company, organized to build the road, received two million dollars in capital stock.[138] Moffat manifested his confidence in old railroad associates by naming Sylvester T. Smith as president and A. C. Ridgway as vice-president and general manager.[139]

The manner of Ridgway's appointment was characteristic, and is amusingly told by him. "I was then in Colorado Springs in charge of the Colorado Springs & Cripple Creek District Railroad which I had just built," he said. "One morning I picked up the *Denver Republican* and saw upon the front page pictures of David H. Moffat and myself. An accompanying article stated that Moffat was to build a railroad to the Pacific Coast, and that I was to be general manager. This was the first intimation I had received that a new road was in contemplation. The same afternoon Moffat called me over the telephone and asked me to come to Denver, as he had some matters that he wished to discuss with me. Upon my arrival at his office he reviewed the situation and asked me to go over the ground, as far as surveyed, and report my opinion. H. A. Sumner had just received his appointment as chief engineer. Together we examined the old Tramway survey up Coal Creek, where the Denver & Northwestern had done some grading on a line previously located. We were of the same opinion in that we believed the cost would be prohibitive, and that the South Boulder route would be preferable to that in Coal Creek Canon. Upon my return I said: 'Mr. Moffat, I would not build that road now, if I were in your place. It will be a very expensive piece of construction.' I shall never forget his reply, delivered with a tone of finality that left nothing more to be said: 'I am going to build this road because I want to develop Colorado—and you are going to build it for me.'

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[138] *Denver Times*, July 17, 1903.
[139] Idem. July 25, 1902.

"Moffat then entered into a discussion of the problems to be met. I soon saw that he had given the subject thoro attention. He spoke of the great coal and timber resources, the wide ranges covered with nutritious native hay, capable of supporting thousands of cattle, of the broad river valleys that he hoped to see checkered with productive farms. He emphasized his instructions that I was to build the best line that I could, not sparing expense, as he was going thru to Salt Lake. He concluded in the most impressive manner with these words: 'I want this road to go down in history as my greatest effort in railroad building.'

"I soon realized that I was listening to a very broad conception based upon a vision of state development far more comprehensive in scope than the Florence & Cripple Creek Road which Moffat had built to open his own mines. There was, of course, no question as to what I would do. Moffat had given me my start in railroading while I was still a boy. He had always treated me more as a son than as a business associate. Had the destination been the coal fields of Routt County, heavier gradients and higher curvature would have served. The curvature projected was ten degrees, whereas a sixteen-degree curve could have been adopted for local traffic. Three tunnel sites had been located at different elevations and it was the intention then to build a short, high tunnel. The line over the hill was never intended as anything but a temporary expedient."[140]

During the summer new surveys were made and the main line location was changed from Coal Creek to the South Boulder. Ten distinct lines were run, five over the Hog Back, three over Rollins Pass proper, one over Devil's Thumb Pass and one over Caribou (Arapahoe) Pass. One tunnel line provided for a bore two and six-tenths miles long, with an elevation of nine thousand, nine hundred thirty feet; a second provided for a four and one-tenths mile tunnel at an elevation of nine thousand, four hundred seventy feet;

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[140] From an interview with A. C. Ridgway.

the third for a five and eight-tenths mile tunnel at an elevation of nine thousand two hundred fifteen feet. The first intention was to construct the high tunnel.[141] Surveys and grading proceeded rapidly in spite of a very broken terrain. So rough was the contour in South Boulder Canon that engineers frequently were obliged to work while suspended by ropes attached to the tops of cliffs.

Financial storm clouds were gathering in the north, however, and a hint of the invisible barrier to be erected came when Gould, who had been friendly, and the Providence and Holland interests, suddenly withdrew their support.[142] The disturbing factor was E. H. Harriman, then just coming into public prominence thru his leadership in Union Pacific affairs. His great power was first manifested by the purchase of Southern Pacific control in 1901. Immediately he began flirting with the Burlington in order to secure a foothold upon its directorate. James J. Hill, who had not been unfriendly to Moffat's plan, stepped in ahead of Harriman and bought a majority of Burlington stock. In retaliation, and with the hope that he could secure his end by gaining control of the Northern Pacific, Harriman bought heavily in the latter road's stock. He believed he had attained his purpose, but learned otherwise to his discomfort. However, he was so well represented that he forced recognition and was admitted, with two Union Pacific associates, to the Northern Pacific board in June 1901.[143] Even then he was working to establish his famous "community of interests" with the Santa Fe, the sole

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[141] An early map, dated 1902, is on file in the chief engineer's office of the Moffat Road that shows the location of ten surveys, together with approaches. A table will indicate the thoro manner in which the problem was investigated.

Tunnels	*Length*	*Elevation, Feet*
Between James Peak and Rollins Pass, Connecting South Boulder and James or Buck Creeks—		
A	2.4 miles	10,000
B	2.6 miles	9,930
C	4.1 miles	9,470
D1	4.5 miles	9,215
D2	5.8 miles	9,215
Rollins Pass—South Fork of Middle Boulder to Ranch Creek	19,750 feet	10,100
Rollins Pass—South Fork South Boulder to North Fork Ranch	30,000 feet	9,250
Rollins Pass—Approximately same location	30,000 feet	9,250
Devil's Thumb Pass—East Side to Crest Only	14,400 feet	10,100
Caribou Pass—North Boulder to Summit on East Side Only	14,800 feet	10,100

[142] *Rocky Mountain News*, December 11, 1912.

[143] Trottman, *History of the Union Pacific*, 287-289.

remaining road to the Pacific in which Harriman did not have control or great influence.

Senator William A. Clark of Montana, and western associates, had incorporated, in 1900, a line between Salt Lake and Los Angeles, which was in a position to offer competition thru connection with the Rio Grande, or with the Moffat Road, when completed. But Harriman had old filings upon part of its route, held by the Oregon Short Line, and it did not take him long to demonstrate to Clark that it would be better to combine with the Union Pacific.[144] This combination upset Moffat's plans for a connection with the Clark Road. In short, Harriman's tremendous financial power, all the more impressive because of its sudden birth, closed all eastern financial gates to the Denver millionaire.

Late in the year 1902 Moffat returned from New York and made the terse announcement: "We have met active opposition from the strong financial combination controlling the roads north of Denver."[145] He grimly added that the Moffat Road would be built regardless of this opposition. In nearly every instance, when a local project had been formed to cross the Divide he had seen the Union Pacific appear with a rival enterprise. The South Park, the Colorado Central, the Kansas Pacific had all passed to Union Pacific control and their Pacific Coast ambitions ended. He believed that he could retain independent control of the Denver, Northwestern & Pacific and was ready to gamble his fortune upon the outcome. Imbued with unusual optimism and courage, invulnerable to sudden alarms as Moffat was, the Harriman opposition only served to fix unalterably his determination.

The Moffat Road was built to Yarmony, one hundred forty-six miles from Denver, by the Colorado-Utah Construction Company, to which Moffat had advanced four million dollars personally, taking as security four millions in bonds and a majority of the railroad stock.[146] Contracts for construction of the first thirty-six miles were let to Orman & Crook of Pueblo and George S. Good & Company of Lockhaven, Pennsylvania, in December, 1902. This was Moffat's answer to the Harriman interdict.[147] It soon became apparent that the opposition was not to be passive, for various individuals filed mining claims upon the tunnel location.[148]

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[144] Idem. 316-324.
[145] *Rocky Mountain News*, December 13, 1902.
[146] *Denver Republican*, May 2, 1912.

Early in March, 1903, the first serious obstacle to actual construction appeared in what is known as the New Century litigation. The Continental Divide enters Colorado on the north near Steamboat Springs, forming the border between Routt County and North Park. It runs due south for a short distance, turns east to form the division between North and Middle Parks, and then takes its southerly course again. The Gore Range juts from the Divide at the first elbow and runs south until it again encounters the Divide in its snake-like course. This rough range is pierced at one point by the Colorado River, and the precipitous canon thus formed offers the most feasible railroad passage of the secondary range. The New Century Light & Power Company filed upon Gore Canon for a reservoir site at the time mentioned, claiming that thru an error in its survey the railroad had not located the canon. Either thru this error or, as the railroad claimed, thru an error in the original government survey, the located line ran over the top of the range and missed the canon entirely.[149] The contest resulted in one of the stormiest legal battles in the history of the road and lasted over a period of several years. The New Century promoters found that they could not win alone, so an assignment of rights was made to the United States Reclamation Service. Acting Commissioner J. H. Fimple of the United State Land Office thereupon handed down a decision in favor of the Reclamation Service. The latter organization filed injunction proceedings in the Federal Court to prevent occupation by the railroad. Judge Moses Hallett denied this petition after a sensational trial.[150] Charles J. Hughes, Jr., general counsel for the road, filed affidavits that charged collusion of an improper character between New Century officials and Reclamation Service agents.[151] Meanwhile, government engineers had been sent into the canon to make borings, which proved to be a disappointment. In one instance bedrock was reached at one hundred ten feet; in another at one hundred feet.[152] The Reclamation Service predicated its claim to the canon upon the premise that a reservoir was needed to irrigate Western Colorado and Southern California lands and, thru unknown influence, the Los Angeles Chamber of Commerce was induced to protest against the use of Gore Canon by the railroad. One by one, Hughes mercilessly punctured the elaborate details of the attack. The undue activity of government agents in arousing farmers to oppose Moffat's plan, the excessive depths of the borings in the canon, the fact that Salton Sea was overflowing, were effectively used in his argument, and the government case crumbled under the force of his logic.[153] By this time the Gore Canon dispute had assumed a national aspect. Various large manufacturing concerns of the Atlantic seaboard, notably manufacturers of electrical machinery and equipment, joined cause with the Reclamation Service and there was indication that Congress was to be asked to legislate in favor of the federal bureau. Altho they conceded that the manufacturers' activity might be legitimately in the interest of their own concerns, Moffat road officials and investors suspected that opposition railroads were behind the concerted movement. A mysterious run on the First National Bank about this time was accredited by newspapers to Harriman and Gould.[154] In order to reinforce its case the railroad sent A. C. Ridgway to Chicago, where he was successful in securing from the Burlington its prior rights, surveys and right-of-way thru Gore Canon, dating back to the early eighties.[155]

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[147] *Rocky Mountain News*, December 19, 1902.
[148] Idem. March 18, 1903.
[149] *Denver Post*, June 15, 1913.
[150] *Denver Times*, September 5, 1905.
[151] *Denver Republican*, November 16, 1905.

The dispute became so acute that it reached the ears of President Roosevelt, who sent to Denver to make a personal investigation and report Carl Ewald Grunsky, his confidential man on the Panama Canal.[156] The President summoned the contesting parties to Washington in November, 1905. In his characteristic, blunt manner he

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[152] *Denver Times*, November 16, 1905.
[153] *Denver Republican*, November 16, 1905.
[154] *Denver Times*, November 16, 1905.
[155] *Denver Republican*, November 16, 1905; *Denver Times*, April 21, 1903. A. C. Ridgway confirmed this statement in an interview with the writer.
[156] *Denver Times*, November 16, 1905.

SENATOR CHARLES J. HUGHES

took charge of the meeting at the outset, calling upon those present to state whom they represented. When the government engineers rose to reply to the query the President interrupted with the comment: "Oh, yes, you represent the power companies and the opposition railroads."[157] The remark left little doubt as to the ultimate outcome and it caused no surprise when, at the close of the meeting, the President ordered the Secretary of the Interior to relinquish all government claims in favor of the railroad. Assistant Attorney General Russell announced on the following day that the Department of Justice had decided to abandon the Gore Canon litigation[158] and, on November 29, United States District Attorney Earl Cranston appeared before Judge Hallett in Denver and requested dismissal of the suit.[159]

While this lawsuit never seriously interferred with the physical progress of the Moffat Road, the risk to investors was very great, because it affected the value of bonds.[160] The progress of the case thru the courts was marked with extreme bitterness, and its ramifications extended into unexpected quarters and caused serious financial disorders in Denver. Attorney Hughes was the commanding figure thruout. He was noted as a lawyer who made his preparations for a lawsuit in the most thoro and painstaking manner, and in this trial he repeatedly confounded the government engineers during their testimony. Had the case been lost it might have brought irretrievable ruin upon the road because of the adverse financial situation; certainly it would have crippled the Moffat Road. Of Hughes it may be said that he never wavered for a moment in his fidelity to Moffat and Moffat Road interests.[161]

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[157] For this information the writer is indebted to Gerald Hughes who, tho not present, was acquainted with all the circumstances immediately upon return of the Denver delegation from Washington.

[158] *Denver Times*, November 16, 1905.

[159] Idem. November 29, 1905.

[160] *Denver Republican*, November 16, 1905; also confirmed by Gerald Hughes.

[161] Charles J. Hughes, Jr., was born in Caldwell County, Missouri, February 16, 1853, the son of Charles James and Serena C. (Pollard) Hughes. In 1871 he took his A.B. at Richmond College, Missouri, and was a law student in the University of Missouri from 1872 to 1873. He married Lucy S. Menefee at Richmond, September 1, 1874. In 1879 he came to Denver, where he practiced law until his death in 1911. Political offices held were: Presidential elector, 1900; member of the Board of Capitol Managers from 1889 until his death; United States Senator from 1909 to 1911. He was professor of mining law, Denver Law School, and a lecturer at the Harvard law school. He also was a member of the American Bar Association and the American Institute of Mining Engineers. Senator Hughes was an indefatigable worker and as a trial lawyer, Colorado has not had his peer. Moffat depended implicitely upon him for legal advice.

He was one of the few men whose faith and determination equalled those of Moffat himself.

The first Denver, Northwestern & Pacific train to reach Corona, engine-changing station on the summit of the Continental Divide, rolled into Rollins Pass on October 2, 1904.[162] The elevation of this pass is eleven thousand six hundred sixty feet and, in building a broad gage railroad to this altitude, Chief Engineer H. A. Sumner had accomplished a triumph,[163] tho a costly one. The topography of the country traversed had been most unfavorable, due to the fact that the canon walls of the South Boulder are cut by innumerable ravines, between which spine-like granite ridges jut forth. These obstructions made necessary thirty-one short tunnels between the foothills and Corona, an approximate distance of twenty miles. The alternate passage from sunlight to inky blackness, the sudden vistas over distant plains or into the depths of the gorge impart to the traveler a confused impression, curiously symbolic of the triumphs and tribulations of the builders.

A wonderful sense of elation accompanied this feat, altho various difficulties halted progress for a time at Arrow, part way down the western slope of the Divide. Thousands of sightseers and tourists made the trip during the ensuing summer, lured by the spectacular nature of the climb. The heart-quickening sensation as the train skirted the eyebrow of a vast abyss just before the distant view of Middle Park unfolded, the odd passage thru the little town of Corona, half-buried in the gloom of a snow-shed, the novelty of picking flowers from the edges of snow banks in July, the majesty of the great white peaks so close at hand, lent a romantic interest to the journey.

Travelers knew nothing of the tragic conditions which one winter's experience had taught the trainmen only too well. Then, terrible blizzards roared over the treeless heights, packing the snow in enormous drifts thru which the snowplows labored, only to have the cuts fill behind them as the blinding clouds of snow hurtled past. Slowly the trains crawled up the Divide, twisting and turning on their tortuous course. The projecting tip of a smoke-stack, with its plume of black smoke, or the explosive panting of the engines alone told that human beings were in the white waste. There were hours when trains were marooned upon the mountain-side, trapped between coaling stations without fuel or water. Alternate freezing or thawing temperatures filled the roadbeds with sheets of ice that crept over the ball of the rail and caused the drive wheels to spin helplessly. There were weeks and months when the line was tied up completely, and the weary watchers at Corona in vain looked down the valley for the tell-tale smoke column. Under these conditions the road could earn nothing, and to the cost of construction was added the crushing burden of operation. Moffat's millions dwindled steadily away.

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[162] The *Denver Republican* of date announced the first excursion to Corona.

[163] Horace Augustus Sumner, the son of Robert S. and Mary Beals Sumner, was born at Stoughton, Massachusetts, March 18, 1845 and died in Denver in 1925. He was one of the great locating engineers in western railroad history and, as a man, endeared himself to all his associates by his kindness, gentleness and humility. He entered the engineering department of the Old Colony Railroad out of Boston in 1865 and practiced his profession for sixty years. His record: Locating engineer on main line of the Burlington, 1868-86; locator on Colorado Railroad, 1886-88; locator on Rio Grande west of Denver, 1888-95; Colorado State Engineer, 1895-97; chief engineer, El Paso & Northwestern, 1897-1902; chief engineer, Moffat Road, 1902-1912; chief engineer, location surveys, California and Oregon, 1912-14. Company absorbed by Southern Pacific. General practice, Denver, 1914 until death.

During the first year of Divide operation several conferences were held in New York with Harriman or his representatives. The railroad king had let it be known that he would help Moffat, but delayed a meeting until Julius Kruttschnitt, director of maintenance and operation for the Union Pacific and Southern Pacific, should have passed upon the project. Meanwhile, two Union Pacific engineers had made a trip over the road as far as Arrow and are believed to have reported favorably.[164] Kruttschnitt's decision, however, is supposed to have been adverse. One of those present at the meeting finally held has given the following version of the conversation when Harriman and Moffat met. Harriman plunged abruptly into the subject, waiving preliminaries.

"Moffat," said the dictator of the greatest railroad system then in existence, "I will help you build the Denver, Northwestern. I will give you fifty per cent interest for what money you have put into the road, and will raise all the funds necessary to take it to Salt

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[164] Information furnished by A. C. Ridgway.

Lake. I will take all the bonds and give you fifty per cent of the stock."

"Mr. Harriman," replied Moffat with considerable heat, "do you think I am a fool or a knave? I refuse your proposition. I know you better now than I have ever known you." Thereupon he turned his back and left the conference. It was most unusual for Moffat to show temper, but he realized that Harriman's proposition, if accepted, would give the latter power to stop operations at any point if he saw fit to do so. The actions and words, of course, definitely ended all attempts at compromise.

Physical difficulties encountered in making the surveys and constructing the roadbed thru Gore Canon proved to be as serious in their way as the New Century litigation had been. Engineers on location found themselves baffled by sheer cliffs that rose from the swirling waters of the Colorado River. An ingenious method was devised to overcome the hazard thus presented. Men were lowered from the tops of cliffs by ropes and, while suspended over the river, drove drill steel into the granite walls. Large trees next were felled at the upper end of the canon and floated down to the desired point, held under control by tow ropes. These logs were attached to the anchored drills by means of steel cables, lifted two or three feet above the water level and bound together at the ends so as to make a continuous bridge past the obstruction. On these swinging footbridges the engineers worked while running line and setting their points.

The first train thru Gore Canon, September 14, 1907,[165] was made the occasion for a celebration. Many prominent Denver citizens were the guests of Moffat on an excursion to Yarmony, then the terminus of the road. It was but an empty gesture, for Moffat had reached the end of his resources.

In Moffat Road annals the year 1907 is still known as the "Black Year at Yarmony." Moffat had exhausted his entire fortune, approximately nine million dollars. A financial depression added to the difficulty. The line was still a long way from the Routt County coal

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[165] *Denver Republican*, September 15, 1907.

Col. D. C. Dodge

fields, which had been counted upon to furnish a heavy tonnage. Construction was shut down completely.

Harriman and Gould were then very bitter against the Colorado railroad builder. In giving expression to what was perhaps a very natural resentment, President Syl Smith had been impolitic enough to write, and cause to be printed and distributed, several vitriolic pamphlets in which the railroad kings were abused personally and without stint. The inevitable result was that they redoubled their efforts to block the Colorado road.[166] This had forced Moffat to base his plea for further assistance upon personal grounds; that is, to seek help from personal friends. It was a humiliating thing for one to do who had been, such a short time before, the most powerful individual in the state, but Moffat swallowed his pride in the interest of the railroad. The friends to whom he applied, themselves involved in banking and railroad operations, did not dare to advance funds in the face of an opposition that might have brought upon their heads a share of approaching financial catastrophe. These refusals, coupled with the aloofness of certain old and wealthy Denver associates, hurt Moffat immeasurably, for his life principle had been always to go to the aid of a friend in trouble.

Help came, in the darkest hour, as manna came to the Israelites. When Moffat had almost given up hope Col. D. C. Dodge, who built the original Denver & Rio Grande Western for General Palmer, came to the rescue. S. M. Perry, one of the directors, induced Colonel Dodge to make a trip to the end of the line, from whence they drove by wagon down the Bear River beyond Steamboat. Altho seventy years old, amply endowed with wealth and long retired from active business affairs, Colonel Dodge rose to the occasion with the spirit of a young man.[167] This section of Colorado was new to him, but he realized immediately that an empire was lying dormant for lack of a railroad line. Upon his return to Denver he publicly announced his faith in the Moffat Road, urged Denver capitalists to come to its aid in the interest of the state and personally led the subscription with an investment of one hundred thousand dollars. The situation was saved as by a miracle, for the public had great faith in the conservative character and experience of this able railroad builder. Despondent shareholders took courage, new blood was infused to such an extent that a total of one million five hundred thousand dollars was quickly raised for the purpose of taking the road to Steamboat Springs. Every dollar of this contribution was Colorado capital. Among the larger subscribers at this time were: Henry M. Porter, S. M. Perry, Charles J. Hughes, Jr., William G. Evans, John F. Campion, Charles Boettcher, Thomas F. Walsh and Lawrence C. Phipps, Sr. The Colorado-Utah Construction Company having succumbed in the course of the struggle, there was incorporated, January 11, 1908, the Denver-Steamboat Construction Company. Colonel Dodge was elected president and gave much valuable advice, as he was the most experienced railroad builder in the group. The road reached Steamboat Springs December 13, 1908.[168] Senator Phipps made his first investment in the Moffat Road during this reorganization, and was probably the largest contributor of all. Altho he had but recently come to the state, he appreciated the necessity for a transcontinental route more readily than many of the pioneer builders of Denver.

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[166] This information was furnished the writer by Gerald Hughes.

[167] *Municipal Facts*, Vol. VI, Nos. 8 and 9. Col. David Child Dodge was born in Shirley Township, Massachusetts, November 17, 1837. He began his career as a surveyor, working on a branch of the Chicago & Northwestern in Illinois in 1853. He served with the United States Commissary at Chattanooga and Memphis during the war and came to Denver as general agent of the Chicago & Northwestern. He was the first freight and ticket agent for the Rio Grande, becoming general manager in 1871. For three years, 1885-88, he was with General Palmer in Mexico as Vice-President and General Manager of the Mexican National Railway. In 1888-90 he was general manager of the Rio Grande Western, and in 1901 became interested in the Great Western Sugar Company. *Denver Times*, December 19, 1918.

Fourteen million dollars had been expended in building the Moffat Road to Steamboat Springs; or better than seventy-five thousand dollars a mile on a railway that had never earned a dollar of net profit. In all the immense territory it traversed west of the Divide, embraced in Grand and Routt Counties, the total population in 1910 was less than ten thousand.[169] Today it would be impossible to construct a railroad into a country so sparsely populated, for the Interstate Commerce Commission holds to the principle that railroads must be built only to serve developed territory; whereas, the Moffat Road had been built to develop the country. Constructed somewhat out of its time, it belonged in period characteristics to the speculative eighties, when a newly discovered gold mine or coal deposit was sufficient excuse to the pioneers to invoke the iron horse. Yet, had it not been for that spirit most of Colorado would be a frontier today. Fortunate it was for Northwestern Colorado that one of the pioneer builders had survived the old century.

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[168] See Denver papers of that date for account.

[169] *U. S. Census*, 1910, Vol. II, 189-230.

The hope aroused by the extension to Steamboat brought only a temporary respite, for the industries of Routt County were not sufficiently developed to make any great difference in income. Moffat had placed the bonds of the Moffat Road with Halgarten & Company of New York as security for a loan of four million dollars, endorsed by him personally. The Denver Railway Securities, a holding company formed for the occasion, had become surety for these notes[170] which fell due in 1911. There were no funds to meet the obligation, nor any possible channel thru which money might be secured. Moffat and Evans visited New York in the spring of 1911, but met with unvarying refusals wherever they applied. By this time Moffat realized that he was hopelessly involved. His fortune and credit were gone and he was ruined beyond hope of redress. His friends in Denver had given their utmost. Yet there was no thought of junking the road. Men like William G. Evans and Senator Hughes were ready to go down to disaster with flying colors.

The knowledge of these things, but, more than all, the realization that his railroad was an uncompleted dream, embittered the last days of Moffat and broke his heart.

"It looked as tho they feared I would be a great man," he said, with a note of pathos, "whereas I had no idea of greatness when I undertook the work of building the Moffat Road. I wanted to do it for the good of the state and nothing more."[171]

David H. Moffat died in New York City, March 18, 1911, at ten o'clock in the morning.[172] News of the death was withheld from the press until evening. Moffat had been the First National Bank since 1867, and the officials of that organization feared that an announcement during banking hours might have disastrous results. But the faith of depositors in this simple, straightforward man was a mighty thing, and the bank resumed the even tenor of its way. Other interests took it over. The railroad was not so fortunate; its stormiest days were ahead.

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[170] *Denver Republican*, May 2, 1912.
[171] *Denver Post*, April 27, 1911.
[172] *Denver Republican*, March 19, 1911.

One of the fascinating features of Colorado history is the abandon with which the pioneer builders constructed railroads in a sparsely populated country with no important industry, save mining, to furnish a revenue tonnage. In each venture of the kind they courted overwhelming disaster, for, unless well fed, the railroad may become a malignant genie to crush the hand that releases its tremendous power. In more than one instance the great railroad builders of the state felt the grinding jaws of the monster in its death agony, yet, with the exception of Moffat, they managed to save themselves before it was too late. If Moffat undertook his *magnus opus* under better industrial conditions, he faced greater financial and construction difficulties. He dared more, suffered more. Of those who amassed great fortunes in Colorado only Moffat returned his all, dollar for dollar, to the soil from which it was extracted—returned it for the further development of its resources and the happiness of its people. That he did this unselfishly none who knew him will doubt. He died a martyr to his passion for empire building; but like all martyrs, left behind the growing inspiration of a great spirit.

CHAPTER II

CRISIS AFTER MOFFAT'S DEATH—EVANS INSPIRES ASSOCIATES—ALLEN BILL FIRST ATTEMPT TO BUILD TUNNEL WITH PUBLIC FUNDS—THE ERB REORGANIZATION—DENVER VOTES BONDS—DECLARED UNCONSTITUTIONAL—SECOND RECEIVERSHIP—OPERATING DIFFICULTIES—WAR BOARD TAKES CONTROL—STATE RAILROAD COMMISSION CREATED—SPECTACULAR TRI-TUNNEL CAMPAIGN—DEFEATED AGAIN—COMMISSION ABOLISHED—CESSATION OF GOVERNMENT CONTROL—THE DARKEST HOUR—EFFORT TO JUNK ROAD—OPPOSITION DEVELOPS—FREEMAN LEARNS TO OPERATE "THE HILL."

EVEN before Moffat's death, as pointed out in the previous chapter, affairs of the Moffat Road had reached a crisis that threatened immediate suspension of operations. Altho the leader had exhausted all his resources and credit and could have given little more practical aid, the moral effect of his name, especially in Colorado, had been a tremendous asset. The loss of public confidence was now endangered at home, where nearly every dollar used in construction had been raised. Enemies of the Denver, Northwestern & Pacific were industriously spreading the poison of distrust, and it behooved Denver investors to do something without delay that would serve to stave off a final crash. Time was needed above all things else; time for a readjustment to meet changed conditions; time to raise additional money so that the wheels would not stop. Within two months, or by May first of this year, a four million dollar loan, secured by the stock and bonds of the road, was due for payment and not a dollar was in sight to meet the indebtedness.

Senator Hughes' death about this time, January 11, 1911, almost demoralized the whole situation. Every man connected with the Moffat Road had unlimited faith in his judgment, and he was in a position, as United States Senator from Colorado, where he might have been of greater service than ever before. His loss was as severe as the loss of Moffat was to be, and greatly discouraged the banker.

At this critical stage William G. Evans, president of the Denver Tramway, who succeeded Moffat as president of the railroad, stepped into the breach and brought all the acumen of an inventive mind, all his then great political influence, to the solution of the problem. He had no money of his own to invest—what there had been of this had long before gone into the railroad—but he refused to listen to any doubts or qualms, or to admit discouragement. By argument, invective and the sheer power of a dominant personality he inspired the less confident of his associates to make one more desperate effort.

Opportunity for a temporary reprieve was offered, almost by accident, thru the existence upon the state legislative calendar of a bill particularly suited to attract and hold public interest in the Moffat Road—the thing most needed at this time. With some remote idea in mind that he could help the railroad, Representative Gaines M. Allen of Denver had introduced House Bill 402. The object, as stated in the enacting clause, was "to promote and increase the general prosperity of the state by constructing a tunnel under and through the base of James Peak, a spur of the Rocky Mountains, to be used for public and semi-public purposes."[173] This was the first attempt to build the Moffat Tunnel with public funds.

The bill had not been inspired but had been drawn and introduced by Allen upon his own responsibility. No one, either in the legislature or outside, had given it particular attention, and it was then slumbering peacefully in committee where, but for Moffat's death, it would have expired. Evans then controlled the Republican organization in Denver,[174] and his adroit mind seized upon this measure as a means out of the dilemma. It suddenly found a place upon the calendar, was brought before the Committee of the Whole, the entire measure after the enacting clause stricken and a substitute measure, approved by attorneys for the road, was introduced. The bill then became known as the State Tunnel Construction Bill, and provided for an issue of four million dollars in state bonds, the proceeds of which were to be used to provide an "open gateway" thru Colorado for transportation purposes. By its terms, the Moffat Road was required, thru its proper officials, to sign a contract for use of the tunnel within sixty days after passage; also, to guarantee either the construction of a line to Salt Lake City from its terminus, or construction of the Dotsero Cut-off by the time the tunnel should be completed.[175]

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[173] Session Laws of Colorado (1911), 637.

[174] William Gray Evans was born in Evanston, Illinois, December 16. 1855, the son of John and Margaret Gray Evans. When his father was appointed second territorial governor of Colorado by President Lincoln in 1862 the family moved to Denver and has resided there continuously since. He was the active Republican leader in Denver for nearly a generation. Evans was one of the organizers of the Denver Tramway Company, its first secretary, and later its president until 1913. The company was organized in 1885 as the Denver Electric & Cable Railway. He was vice-president of the Denver, Northwestern & Pacific at the time of Moffat's death. On December 12, 1883, he married Cornelia L. Gray in Denver. He held the degree of B.S. from Northwestern University, founded by his father. From the date of his father's death until his own occurred he was chairman of the board of the University of Denver.

The proposed tunnel was to extend from Tolland on the east side of the Continental Divide, to Arrow, engine-changing station on the west side, was not to exceed five miles in length, and could be operated either by steam or electricity. Within sixty days after the compact had been signed between the state and the railroad, the Moffat Road and the Transcontinental Tunnel Company, Moffat's original tunnel corporation, were to transfer to the state all rights-of-way, surveys, estimates and filings for a tunnel site, and were to execute a lease of the tunnel for a fifty-year period. Provision was made for eventual ownership by the railroad, in the event that it had paid off the bonds within that time. The bill provided for a commission of five, including the governor of Colorado, the attorney general, the state treasurer, who were to select as the other members two men, one a railroad engineer. Bonds were to run for fifty years, with interest at four per cent.[176]

No difficulty was encountered in the passage of this bill. Evans was then one of the most powerful Republican leaders in the state. The Democratic governor, John F. Shafroth, whose political affiliations were not with the Moffat Road builders, failed to approve the bill within the required thirty-day limit. Under provisions of the Colorado constitution this automatically referred the bill to a vote of the people. It was filed with the Secretary of State, June 5, 1911, submitted to the electorate at the general election of 1912 and, by a vote of ninety-three thousand one hundred eighty-three nays to forty-seven thousand three hundred eighty-three ayes, was lost.[177]

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[175] *Denver Republican*, March 22, 1911.
[176] *Session Laws of Colorado* (1911), 637.

Thus failed the first attempt to finance the tunnel by general taxation. It provided for a loan of state credit to a private corporation and, in the light of later legal decisions, probably would have been declared unconstitutional by the courts; but it served its purpose in giving to stockholders of the road a new hope, and it gained the required time for negotiations. The next decade was to be spent in a succession of attempts, similar in purpose but varying somewhat in method. The final solution had been stumbled upon and it required only the right key to unlock the public treasury.

Denver investors, who were in control of the railroad thru control of the Railway Securities Company, holder of eight-elevenths of the first mortgage bonds and eight-elevenths of the capital stock, subject to the existing lien, raised an additional half-million dollars to apply upon the four million dollar loan, and thus secured an extension of time until May 1, 1912. The company was composed practically of the same group that had organized the Denver-Steamboat Construction Company, and the Moffat estate owned one-half of the Securities Company.[178]

Failure of the Securities Company to meet the principal and interest on its collateral trust notes in 1912 threw the Moffat Road into a short receivership, under the administration of Lawrence C. Phipps, Sr., and Charles Boettcher. Bondholders felt the necessity of having a practical railroad man in active charge of operations, and, in May, 1913, a reorganization was effected, the name changed to the Denver & Salt Lake Railroad Company and the receivership terminated.

The Erb reorganization of 1913 received its name from Newman Erb of Pere Marquette fame, who took the presidency and agreed to furnish one-half the funds necessary to extend the line to Craig in Moffat County, created this year from the western half of Routt County in memory of David H. Moffat. As a matter of fact, he brought no money of his own into the enterprise, but the local investors were in no position to be particular. Two million dollars were needed for this construction. Denver investors promptly furnished their quota, the largest subscribers being L. C. Phipps, Sr., Col. D. C. Dodge, Henry M. Porter and Gerald Hughes, who had succeeded his father as general counsel. Erb failed in his promises and again it was Denver capital that advanced the railhead. Erb's principal backers were D. F. S. Pearson, an English capitalist, who went down on the Lusitania, and Frederick H. Prince of Boston, but the entire amount of new capital introduced by Erb during his regime did not exceed one-half million dollars.

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[177] *Abstract of Votes*, General Election, November 5, 1912. Records of the Secretary of State.
[178] *Denver Republican*, May 2, 1912.

The Erb scheme for rehabilitation of the Moffat Road embraced a second attempt to finance the tunnel thru use of public funds. This took the form of an amendment to the charter of the City and County of Denver and was passed without difficulty at a special election held February 14, 1913.[179]

The existing charter limitation of fifteen years for all bond issues was extended to fifty years by this amendment and the commission was authorized to enter into a conditional contract with the Denver & Salt Lake, to determine the amount of bonds necessary to complete the city's share of construction costs and to submit the proposed bond issue to the people. Joseph C. Helm, Charles MacAllister Willcox and Jesse E. Fleming, named in this document as the tunnel commission, signed a tentative contract whereby the railroad was to supply one million five hundred thousand dollars contingent upon the voting of a three million dollar bond issue by the electorate of Denver. After an active campaign the voters confirmed these arrangements at the regular city election on May 27, 1913, authorizing the bonds in the amount asked by a majority of nearly six thousand. The contract provided that the Moffat Railroad should be in operation to Salt Lake within five years after signature of that document. If the road should not have taken up the bonds at the end of the fifty-year period the city then was to take over and operate the tunnel. Incidentally, Erb announced just before the election that he had raised all the money necessary to extend the road to Salt Lake City. The geological survey was made by Professor D. W. George, state geologist. A tunnel was located under direction of J. Vipond Davies of New York, D. W. Brunton and J. Wellington Finch of Denver. This was to be four and six-tenths miles in length.

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[179] Section 355, Charter of the City and County of Denver (1914), reads: "All the powers granted to the City and County of Denver by Article XX of the constitution of the State of Colorado, and otherwise existing by operation of law, including the power of eminent domain and authority to make all necessary filings under the laws of the State of Colorado and the United States are hereby conferred upon said tunnel commission, to acquire, lease, and dispose of a transportation tunnel, together with the necessary approaches thereto, through the main range or divide of the Rocky Mountains under or near James Peak, to be known as the Moffat Tunnel, for the purpose of transporting freight, passengers, water and electricity, or for any one or more of such purposes; Provided, however, that in the event said tunnel shall be originally constructed for the transportation of freight and passengers the right shall be retained by the city and county in perpetuity, to construct and operate or to authorize the construction and operation through such tunnel of an acqueduct, pipe line or other apparatus for conveying water from the western to the eastern portal for use by the City and County of Denver, and its inhabitants for domestic use, irrigation, power or other uses, also the right to extend or authorize the extension through the same of cables, wire or other apparatus for conveying electricity manufactured west of the western portal thereof, to be used for power, lighting or other purposes, by the city and its inhabitants, and to permit the use thereof, upon some fair and equitable basis, by any and all railway lines desiring such use; but in enlarging such tunnel or otherwise preparing it for and subjecting it to the said water or electrical uses, the original use to which it shall have been subjected shall not be destroyed, impaired or needlessly interrupted. And if, in constructing said tunnel, mineral in paying quantities shall be discovered therein the commission shall have power to make such contracts and take such other steps in relation thereto as will secure for the city and county the benefit of such discovery or discoveries."

Immediately after the election an injunction proceeding was filed in the district court of Denver to prevent the issuance of bonds. While District Judge George W. Allen declared the issue valid, the Supreme Court of Colorado on April 14, 1914, reversed the decision on the grounds that the state constitution prohibited a city from lending its credit to a private corporation.[180]

The proponents of the amendment had thought that ample precedent existed for such an action. The city of Cincinnati began construction of the Cincinnati Southern Railroad in 1872, issuing before its completion eighteen million dollars in bonds, and constructing three hundred and thirty-eight miles of line.[181] The Ohio constitution likewise prohibited any political subdivision of the state from becoming a stockholder in any private corporation, but in the latter instance the city was sole owner and the constitution did not apply. The city of Cincinnati secures great commercial advantage from this railroad in addition to the receipt of a large annual revenue from its lease.

The Supreme Court decision was a severe disappointment and

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[180] Lord v. Denver, 58 Colo. I (1914).

[181] *Municipal Facts*, Vol. VI, Nos. 8 and 9, 1923.

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set-back to the railroad investors. As an alternative measure Erb proposed that the tunnel be built by private capital, and offered to provide one-half the necessary amount if local stockholders would match these funds. Colonel Dodge, S. M. Perry and Henry M. Porter immediately secured pledges for two million, five hundred thousand dollars in subscriptions. Phipps, Boettcher, Dodge, Porter and Gerald Hughes were the largest individual subscribers, while the Denver Clearing House banks took an unprecedented action by agreeing to subscribe one million dollars.[182] Again Erb failed to keep his part of the compact, and, in the latter part of 1916, under pressure from Denver bondholders he withdrew from the affairs of the road without having made good any of his promises.[183]

Strangely enough, the Denver & Salt Lake showed its first net profit during the Erb regime, but later analysis revealed that the president had starved the road for maintenance to bring this about. While Erb had completed the extension to Craig in 1913 he had left the roadbed and equipment in deplorable condition. The Moffat Road was forced into its second receivership by this train of events, and, on August 17, 1917, the Federal court in Denver appointed Charles Boettcher and William R. Freeman receivers, the latter in active control of operation.

With unfailing optimism the promoters of the Moffat Road confidently expected that, when the road would have reached Craig the operating deficit would be overcome. They found that it requires time to develop a raw country and market the produce, and were grievously disappointed in their expectations. A substantial increase in tonnage was shown, it is true, but not sufficient to fill the ever-yawning maw of the iron monster. The first shipments of coal over the Moffat Road for the year 1908 totaled three thousand tons, or three one-hundredths of the state total. By 1916 the output had been swelled nearly to one million tons, or eight and eight-tenths per cent of the total.[184] Livestock shipments had commenced in 1904 with an annual total of one hundred eighty-five cars. By 1916 the carload lots totaled two thousand, one hundred ninety-one.[185] While farm lands remained comparatively cheap, the population per square mile in Northwest Colorado was far below the state and national averages, and in these figures was found the secret of the failure.[186] The natural resources were there, but the man power to develop them was lacking. The limited production and high cost of railroad operation forced shippers to pay ruinous differential rates on both class and commodity shipments which in the former instance, except for the shortest and longest distances on the Denver & Salt Lake, even today are over twice as high as those on other roads for similar distances.[187]

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[182] *Denver Post*, September 21, 1916.
[183] Idem.
[184] State Inspector of Coal Mines, Report of 1925, 63.

The most serious obstacle encountered in operation was that which had afflicted the Moffat Road from the moment that it topped the Continental Divide—snow blockades. Despite the two miles of snowsheds constructed on Rollins Pass and its approaches, winter operation devoured profits more rapidly than they could be made. Even in summer, operation "over the hill"—as trainmen referred to the pass—was exceedingly costly. It has been estimated that forty-one per cent of the operating cost on the Moffat Road has been due, until recent years, to snow blockades, most of which have occurred around Corona.[188]

Engine changes were made at Tabernash on the Pacific Slope and Tolland on the eastern approach. Between these points were located all the four per cent grades and the heaviest curvature, in some instances a sixteen-degree curve having been employed. Four Mallet type engines were required to haul a train of twenty-two freight cars over the hill, and five to take across twenty-four cars. Between Tabernash and Denver the running time of such trains frequently extended from fourteen to sixteen hours, altho the distance is less than ninety miles. The Moffat Tunnel, which will give the road a maximum grade of two per cent and eliminate twenty-three miles of line, will enable one ordinary consolidation engine to haul a train of twenty-two cars between the points named in less than one-half the time.[189]

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[185] Denver Union Stockyards Company, Report of 1925, 28.

[186] In 1920 the percentages were: Grand County, 1.4; Routt, 3.9; Moffat, 1.1; Colorado, 9.1; U. S., 35.5. *U. S. Census Report*, Vol. I, 31-96.

[187] *Commercial and Industrial Survey of Grand, Moffat and Routt Counties, Colorado.* Daniels, University of Colorado, 1925, 70.

[188] *Municipal Facts*, Vol. VI, Nos. 8 and 9. *The Explosives Engineer*, Vol. 3, No. 2, 52. *Compressed Air Magazine*, Vol. XXX, No. II, 1136.

Not all of the operating expense over the hill was due to snow blockades. There was to be considered also the "lift," as it is known in railroad parlance. In addition to resistance due to speed and friction in level running, a locomotive hauling a train upgrade meets a resistance of twenty pounds per ton for each per cent of grade. On the Moffat Road's four per cent grades this gravity lift added eighty pounds to each ton hauled. The wind blowing over the pass sometimes attains a velocity of ninety miles an hour, while the temperature ranges as low as fifty degrees below zero. "One does not have to be a practical railroad man to grasp some of the effects of these physical handicaps and to appreciate in a general way the relief the tunnel will offer."[190] Snow blockades have been known to last sixty days or more on this road, completely tieing up traffic west of Tolland.

Most of the investors lost heart when the Moffat Road went into receivership for the second time. All efforts to finance the tunnel had failed and the Supreme Court decision in the Lord case definitely seemed to block the way toward construction by public funds. Many were ready to sell the railroad for what its equipment and rails would bring and to pocket their losses. Evans was as sanguine outwardly as ever, whatever his inner feelings might have been. He was never known to admit that defeat was possible, and his attitude was a constant inspiration. When this country entered the World War an effort was made to have the United States War Board take over administration of the road and finance the tunnel. The latter proposition met with prompt and definite refusal, while the board advised that the struggle to keep the line in operation be abandoned. Receiver Freeman was an important factor at this time in maintaining operations. He was very active, persistent and aggressive in his arguments for government control and government funds with which to meet pressing obligations. These tactics finally had their intended result and the board placed the Moffat Road under control of the Burlington. The government purchased more than one million dollars of receiver's certificates, the proceeds yielding a sufficient amount to take care of the more important needs. A small yearly rental also was paid, the trainmen's threatened strike averted, and the weary struggle once more renewed.[191] The demand for increased production brought about by the war reacted beneficially upon Northwestern Colorado, which reached its high water mark industrially during the period of hostilities. This was true of coal production, livestock shipments and farm products, the only important activities of the section. The banner year, except for coal production, was 1919.

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[189] *Municipal Facts*, Vol. VI, Nos. 8 and 9.
[190] *Compressed Air Magazine*, Vol. XXX, No. III, 1165.

With the bondholders temporarily relieved from the drain of annual deficits, Evans gave his attention to a new plan for tunnel construction while conditions were thus favorable. The tenacity of this man was one of his remarkable traits, and he held to the belief that public funds could be secured for the tunnel. During the legislative session of 1919 he caused to be introduced House Bill No. 206, by Representative Hugh R. Steele of Denver, whose father had been governor of the popular government of Jefferson Territory.[192] Opposition railroads were so engrossed in the novelties of wartime operation that they allowed this measure to pass without serious effort to kill it, with the result that the act was approved by Governor Oliver H. Shoup April 9, 1919. The bill established the State Railroad Commission and gave it power to condemn railroads, specifically mentioning the Denver & Salt Lake: furthermore, to establish, construct and equip for operation by electricity a main range tunnel and the Dotsero Cut-off, and to exercise upon other railroads within the state similar powers to those conferred in connection with the Moffat Road.

Governor Shoup appointed as members of the Railroad Commis-

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191. The amount of receiver's certificates purchased by the government was $1,462,000, of which there was paid out for taxes $260,000; fuel and maintenance, $300,000; equipment trust notes, $150,000; wage arrears, $152,000; repairs and betterment, $600,000. The annual rental paid was $351,000. *Rocky Mountain News*, August 25, 1919.

192. *Session Laws of Colorado* (1919).

sion William G. Evans, J. Wilson Carey, John L. McNeil, Otis Scruggs and J. H. Mitchell. Two appointments immediately were made by this body: Herbert S. Hadley, former governor of Missouri, who then occupied a chair at the University of Colorado, as general counsel; and L. D. Blauvelt, who had been assistant chief and chief engineer of the Moffat Road, as chief engineer.

Since the legislature had refused to place state funds at the disposal of the commission, Evans appealed to Mayor Dewey C. Bailey and the council of the City and County of Denver. The council appropriated ten thousand dollars for surveys, and Major Blauvelt was placed in the field with three parties during the summer of 1919. The following spring Mayor Bailey called a meeting of Colorado mayors at the City Auditorium and, on March 1, 1920, the Tri-Tunnel campaign was launched with much ado. Most of the mayors in attendance were from northern Colorado and Western Slope towns, all of which would benefit by construction of the tunnel. The assemblage, consequently, joyously endorsed the plan, and the opposition suddenly was astonished by the existence of a formidable organization. The plan had several features certain to make it a popular proposal.

The result of Major Blauvelt's surveys, reported at this meeting, comprehended a scheme for three tunnels thru the Continental Divide. The first of these was the Moffat Tunnel, to be six and two-tenths miles long, located between Tolland and Vasquez, to connect the drainage basins of the South Platte and Colorado rivers. The estimated cost of this work was seven million, four hundred sixty-three thousand dollars. The chief engineer stated that the saving to be made in the operation of this tunnel, based upon the train-mile cost of Moffat Road operation, would be sufficient to pay interest on the entire bond issue for the three tunnels. He estimated that operation of the line over Rollins Pass cost the Moffat Road more than eight hundred thousand dollars annually, and, having occupied the positions he had with that road, his figures may be accepted as having a high degree of accuracy.[193]

The second tunnel suggested was to be driven thru Monarch Pass on the Denver & Rio Grande Western between Garfield and White Pine in Gunnison County, to connect the drainage basins of the Gunnison River, a tributary of the Colorado, and the Rio Grande River, which empties into the Gulf of Mexico. The elevation of this bore was to be nine thousand five hundred sixty feet, the length five and eight-tenths miles. The cost was estimated to be the same as that given for the Moffat Tunnel. The Rio Grande, which had crossed Marshall Pass in 1881—the first railroad across the high Colorado Rockies—was to benefit by the construction, which would have saved approximately thirteen hundred feet in elevation to the line. According to Major Blauvelt's calculations, based upon tonnage moving over the pass annually, three hundred fifty thousand dollars could be saved the Rio Grande by the Monarch Pass tunnel.

The third tunnel was to be driven thru Cumbres Hill on the Denver & Rio Grande Southern narrow gage to connect the drainage basins of the Rio Grande and San Juan rivers, the latter a tributary of the Colorado. Its object was to open to trade and commerce the San Juan Basin in Southwestern Colorado and Northwestern New Mexico. The estimated length was two and one-fourth miles, and the estimated cost three million and forty-seven thousand dollars. The elevation of Cumbres Pass is ten thousand and fifteen feet, and the tunnel, at an elevation of nine thousand, five hundred sixty feet, was to save four hundred fifty-five feet. The old Cumbres Hill route, built in the early days of Colorado railroading when bond issues were given in payment for construction work, had been extravagantly located in order to use up an excessive issue. The Tri-Tunnel plan, therefore, included the relocation of the line up the Los Pinos River. A survey also was made by Major Blauvelt over Wolf Creek Pass at the western edge of the San Luis Valley, but it lacked certain advantages of the Cumbres route, and little consideration was given this fourth line.

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[193] Report of Major L. D. Blauvelt to the State Railroad Commission, 1920. *Municipal Facts*, Vol. III, No. 10.

The total bond issue asked to cover the three projects was eighteen million five hundred fifty thousand dollars, which was to include complete electrification of each tunnel. Provision was made in the submission bill that construction should start simultaneously upon the three bores. In March of this year Rollins Pass was closed for three weeks by snow-blockades and many head of livestock starved to death in Middle Park because of inability to haul in hay to meet the emergency of the deep spring snowfall.[194] The State Highway Commission, of which Major Blauvelt was chief engineer, and the Moffat Road, began at the same time to reopen lines of communication, the former using tractors to clear Berthoud Pass. This was the first attempt ever made to open Berthoud so early in the year, and the experiment was highly successful. Automobile trucks had broken thru and delivered supplies in the Park before the railroad could operate Rollins Pass. The demonstration once successfully made, the Highway Commission has since been able to keep Berthoud passable for a large part of the winter months. But the real object had been to demonstrate the handicaps under which the Moffat Road operated, and proponents of the Tri-Tunnel measure used the propaganda to great advantage during the campaign.

With Major Blauvelt's surveys at hand, Governor Hadley drew the Tri-Tunnel bill as an amendment to the state constitution. This was submitted to attorneys for the road and met their approval. It provided for fifty-year, five per cent bonds, free of state taxation.[195] Tunnels were to be owned in perpetuity and operated by the state. The measure was initiated under Colorado laws and submitted to a vote of the electorate at the general election, November 2, 1920. The campaign for adoption was conducted by Evans, Hadley and former Governor George A. Carlson of Colorado. In Denver Erskine R. Myer, later attorney for the Moffat Tunnel Commission, handled the propaganda. Speakers were sent thruout the state to the limit of the Railroad Commission's finances, but proponents of the three tunnels were badly handicapped for lack of funds. On the other hand, the opposition had unlimited means and spent a great sum of money.

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[194] Idem.

[195] Report of L. D. Blauvelt. Records of the State Railroad Commission.

The fight made upon the Tri-Tunnel bill centered in Pueblo, and was conducted by prominent leaders there, who believed the Moffat Tunnel would be detrimental to their section of the state. In Denver it carried by a vote of three to one, but failed of adoption in the state by approximately ten thousand votes. Up to that time the vote was the largest ever cast upon a constitutional amendment in the history of the state.[196] In an interview published in the *Rocky Mountain News* a few days after the election Governor Hadley stated the result had demonstrated that the cost of the tunnel eventually must be borne by the people to be benefited and suggested the creation of a special improvement district for this purpose.[197] Immediately after defeat the Railroad Commission announced that it had started work upon a plan to divide the state into three districts and to submit individual tunnel bills to the taxpayers of the respective districts.[198]

The effort of the commission had proven so nearly successful that opposition railroads became greatly alarmed and exerted their full influence to prevent a second attempt from this source. Senate Bill No. 131, introduced by State Senators Elliot and McFadzean, during the succeeding session of the legislature, provided for repeal of the Railroad Commission Act. The commission was unable to muster sufficient support to combat the powerful railroad lobby that flooded legislative halls, and the bill was passed and signed by Governor Shoup April 7, 1921.[199] Here Evans displayed his political sagacity again. A working unit was saved thru a senate joint resolution that seemed to carry no teeth.[200] This authorized the governor to appoint a transportation committee, which should present to the Interstate Com-

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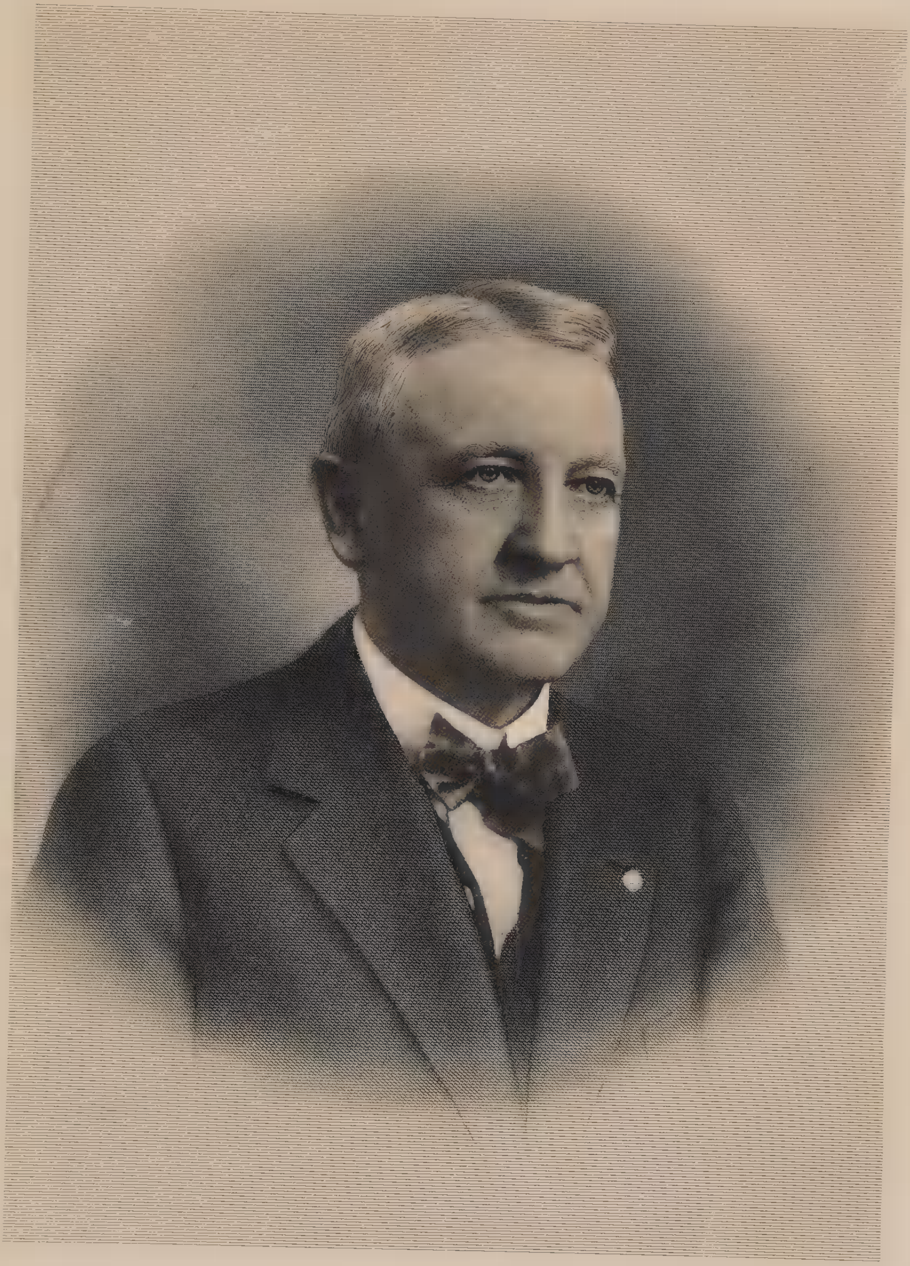
[196] Secretary of State. Abstract of votes, General Election, November 2, 1920.

[197] In a letter to William G. Evans, chairman of the State Railroad Commission, partially quoted in the *Rocky Mountain News*, November 7, 1920, Governor Hadley suggested a canvass to ascertain sentiment in the three districts toward formation of special tunnel improvement districts. This antedated the draft of the Moffat Tunnel Bill by more than one year, and is the earliest authenticated reference to the improvement district plan of which we have record. Many have claimed the honor of having originated this plan.

[198] *Municipal Facts*, Vol. III, Nos. 11 and 12.

[199] *Session Laws of Colorado* (1921), 745.

[200] Idem. Introduced by Senators Callen, Follett, Bannister, Rockwell and Tobin.



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merce Commission facts relative to the transportation barrier in Colorado. It contained a clause stating that "urgent public necessity exists in Colorado for the betterment of its present railroad routes—particularly those between the eastern and western portions of the state." The governor appointed upon this commission Dr. Charles A. Lory of Fort Collins, president of the State Agricultural College; F. L. Tobin of Oak Creek, T. S. Nance of Denver, James F. Kyle of Montrose and Merle D. Vincent of Grand Junction. In so far as ability to carry on another state-wide campaign was concerned the committee was as impotent as supposed by the opposition, but at a later and more acute state in the history of the Moffat Road this committee was to prove itself not wholly innocuous.

While actual construction of the Moffat Tunnel has conclusively proven that only one tunnel could have been built and electrified with the funds allotted in the Tri-Tunnel bill, and that the taxpayers of the state eventually would have been called upon for an aggregate varying from forty to fifty million dollars, the campaign paved the way for the Moffat Tunnel District and made possible its successful creation. The spectacular nature of the campaign, the widespread publicity, the great issue and interests involved, the narrow margin by which the bill was beaten, but more than all, the fundamental soundness of the plan from the standpoint of political and industrial unity made it inevitable that the question would be brought before the public again. One cannot but admire the daring, the strategic insight and the statesmanlike vision of Evans in this move. The probability remains that, once the Moffat Tunnel has demonstrated its ability to develop natural resources and weld the state into a more compact whole, Southern Colorado will clamor for the tunnels it repudiated.

Many of the Moffat Road bondholders lost heart completely when the Tri-Tunnel defeat was registered. They regarded this as the final test upon the question of construction by public funds. The tremendous cost of maintenance and operation convinced them that the Moffat Road was but a modernized version of the cup of Tantalus, into which an endless stream of gold might be poured without issue. Many of the active partizans who had stood shoulder to shoulder with Moffat had died. Senator Hughes and Colonel Dodge were gone. Of the leaders who remained Evans, Gerald Hughes, who had by this time become one of the largest investors, and Senator Phipps, who contributed more money to the road than anyone in its history with the exception of Moffat, took the most active part in the road's affairs. Even the unswerving loyalty of the citizens of Denver, who had twice voted for construction of the tunnel, was forgotten by some of the bondholders. This popular adherence to the city's great traditions and ambitions was a wonderful demonstration that Denver had not lost her pioneer vigor; an extraordinary tribute to the dream and the faith of David H. Moffat.

On November 26, 1921, there was filed in the District Court of Adams County a creditor's suit—McPhee & McGinnity v. The Denver & Salt Lake Railroad—that was intended as the entering wedge in the real movement toward dissolution. The Bankers Trust Company of New York, representing the bondholders, intervened and asked suspension of operations and the sale of the railroad's rolling stock, rails and other physical equipment. All of the bondholders were not in sympathy with this development, and the statement is made that the suit was an anomalous proceeding in that the corporation representing the local bondholders acted in opposition to their desires.[201] There was no lack of unanimity in the attitude of Northern Colorado and Western Slope cities and chambers of commerce. A veritable flood of protests poured into the court, and at one time some twenty-five attorneys appeared before Judge Samuel Johnson, each seeking to file petitions in intervention.[202] Among these petitioners was the Transportation Committee of the State of Colorado, which caused a sensation when it offered to buy the road in the name of the state, or to take it over and operate it for the revenue. This move was pure frontier-day bluff, as the committee had no authority to make such an offer, nor any means whereby it could finance so large a project. Its ability to arouse public interest and indignation, however, was a very real and tangible weapon.

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[201] Statement of Gerald Hughes to the writer.
[202] Statement of Attorney Erskine Myer to the writer.

The general and widespread opposition, including petitions in intervention from the City and County of Denver and the Denver Civic and Commercial Association, served as warning that a public storm might break if the plan to junk the railroad was pushed to an extremity. Added to this, Judge Johnson manifested a strong disinclination to allow the suit to take its regular course thru his court. He received and filed all petitions but consistently refused to pass upon the questions raised; neither would he ever rule upon them, nor upon the main cause at issue. In so handling the case he rendered a conspicuous service to the Moffat Road, to Denver and to Northwestern Colorado. In the face of these objections the Bankers Trust Company agreed not to press its motion for dissolution, but to give the Denver & Salt Lake further opportunity to win success. To this day the case has never come to trial and, of course, will never be revived now that the tunnel is a fact.

About this time another factor entered into the situation that was used with telling effect during the preliminary hearings in the case cited. Receiver Freeman began in 1921 to effect certain improvements in roadbed, equipment and methods of operation, that he believed would enable the Moffat Road to show a genuine net return. Altho the years 1921 and 1922 were the darkest in Moffat Road history, Freeman did not lose faith in his ability eventually to eliminate the annual deficit. This represented an extraordinary amount of faith, indeed, for during 1920 and 1921, immediately after the War Board had relinquished control, the annual net operating deficit had been over one million dollars per year.[203] There was no longer hope of assistance from the government. The road had been a steady loser for twenty years. Interest on the bonded indebtedness had gone unpaid year after year. An application to the Interstate Commerce Commission for six million, five hundred thousand dollars with which to construct a tunnel had been refused. At the time of this application, a high railroad official of the Burlington, who had been called in by the commission for consultation, had bluntly given as his opinion that the Moffat Road never could be successful.[204]

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[203] See annual Receiver's reports for these years, State Public Utilities Commission.

The result of Freeman's economies first became apparent in 1922, when the net operating loss dropped to approximately two hundred thousand dollars. In 1923 he reduced this amount to about fifteen thousand dollars, and by the end of the year 1925 the receiver's net profit was over five hundred thousand dollars.[205] He had been able to accomplish this remarkable feat thru a steady upward trend in shipments after the war, but more especially by learning how to operate "the hill" to better advantage. Immediately after the armistice had been signed production in Northwestern Colorado slumped to an alarming degree. The demand for fuel slackened, the cattle industry suffered to such an extreme extent that shipments of livestock over the Moffat Road declined from a high mark of three thousand, one hundred seventeen cars in 1919 to one thousand three hundred sixty-six cars in 1922.[206] Homesteaders, who had been able to make a success of farming during the war, were forced to abandon their efforts and leave the country. The tide began to turn in 1921. In solution of the snow hindrance, effective relief was given by the rapid increase of telephone stations, and water and coal sidings on Rollins Pass and its approaches. Most helpful of all was an ice-machine built under Freeman's direction, which broke up and scooped from the track ice caked between the rails and over the balls of the rails. The snowplows always had been able to handle the largest drifts on the track, but they were rendered as helpless as passenger and freight locomotives when the snow melted and froze again. This flanger it attached to the rear of a snow-plow, and works while the engine is running. A grating of steel picks is raised and lowered continuously, chipping the ice into small fragments, which are then cleared from the track by a scoop attachment. Blockades of long duration were eliminated, winter running time vastly improved and an all-year service furnished Northwestern Colorado.

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[204] Statement of Gerald Hughes to the writer.

[205] The actual figure is $533,322.10. *Annual Report, Denver & Salt Lake Railroad,* 302. State Public Utilities Commission.

[206] Denver Union Stockyards Company, Report, 1925. 28.

The discovery was made in 1923 that the high plateaus and rich river valleys of Grand, Routt and Moffat counties would grow ideal head lettuce. The industry increased rapidly and within two years Routt County had more than two thousand acres in head lettuce cultivation, while Grand County had one thousand, seven hundred and five acres devoted to this industry. The per cent of state total for head lettuce furnished by these counties in the year mentioned was thirty-five and four-tenths.[207] The discovery of oil fields in Moffat and Routt counties also contributed a heavy tonnage to the shipments over the Moffat Road, reaching a total production of one thousand eight hundred sixty-three barrels for the two counties in 1925.[208]

Even before adoption of the Moffat Tunnel District Bill there were evidences that the Road had passed its greatest difficulties. Improved methods of operation, and a steady increase in the production of coal mines, oil wells and agricultural products gave investors a ray of hope. Altho the road never could have been other than a local line without the tunnel there was reason to believe that it would have survived in any event.

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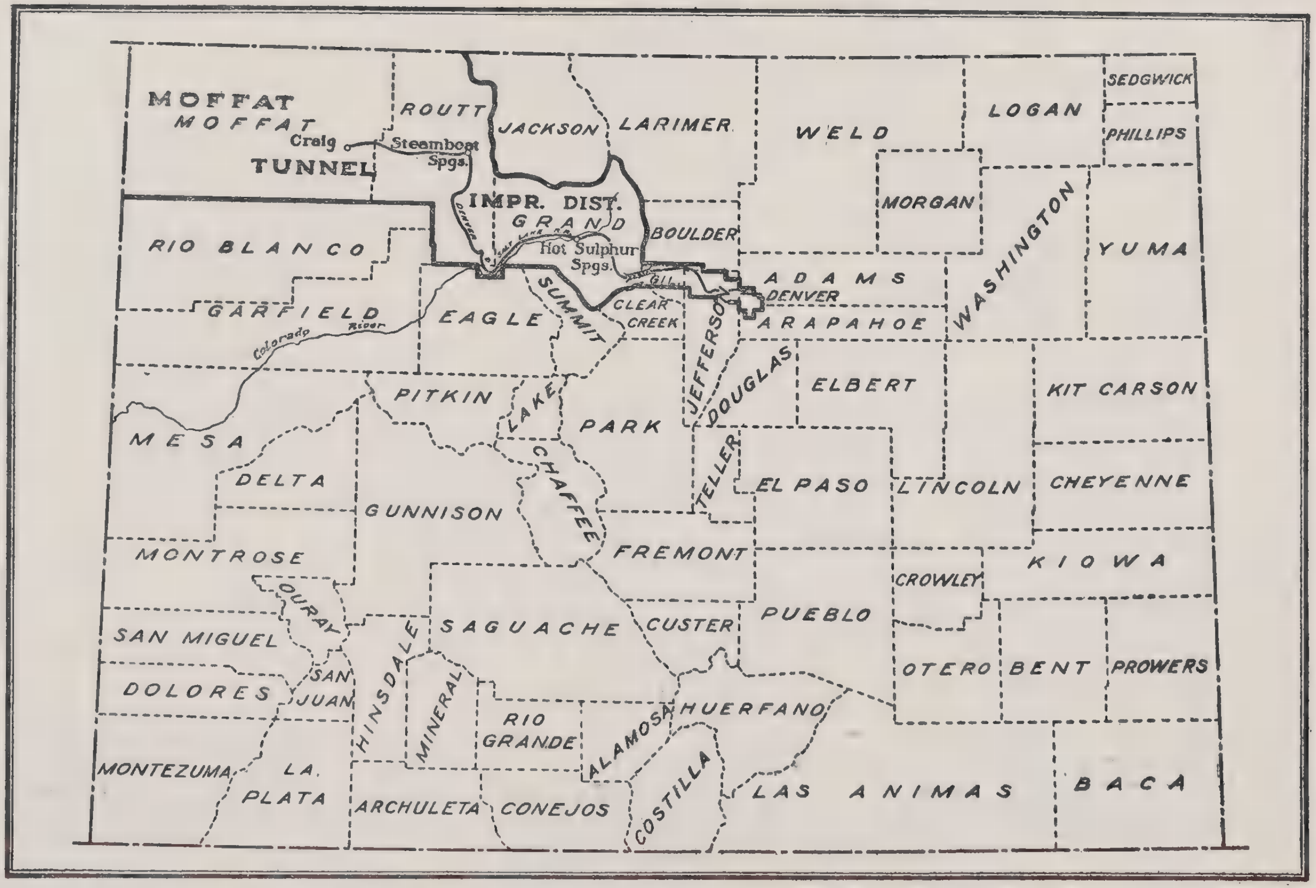
[207] Colorado Year Book (1925), 76.

[208] *Rocky Mountain News*, January 1, 1926. Table compiled by the State Board of Immigration.

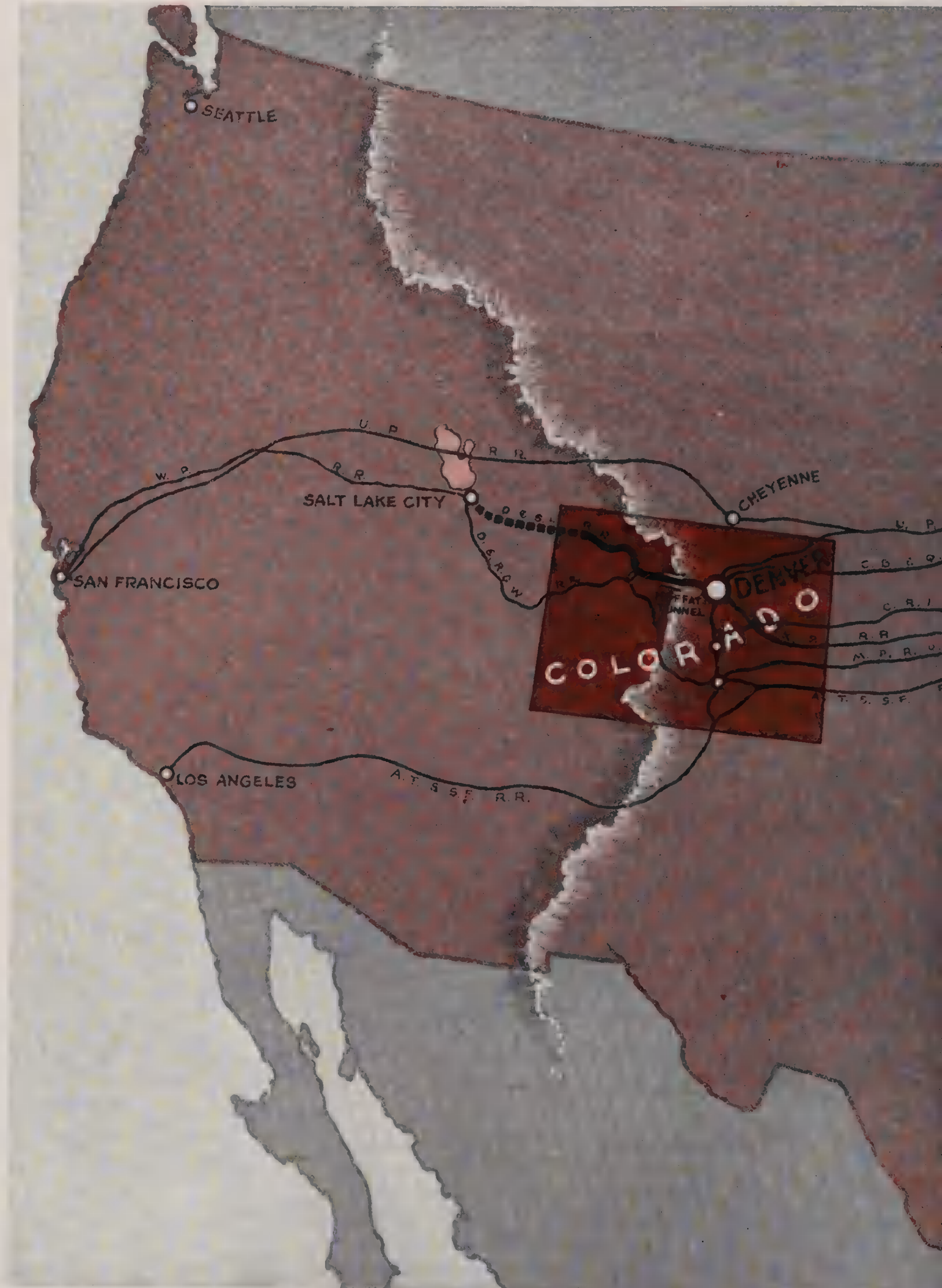


MAP OF THE TUNNEL DISTRICT, CREATED BY THE COLORADO LEGISLATURE

PART THREE

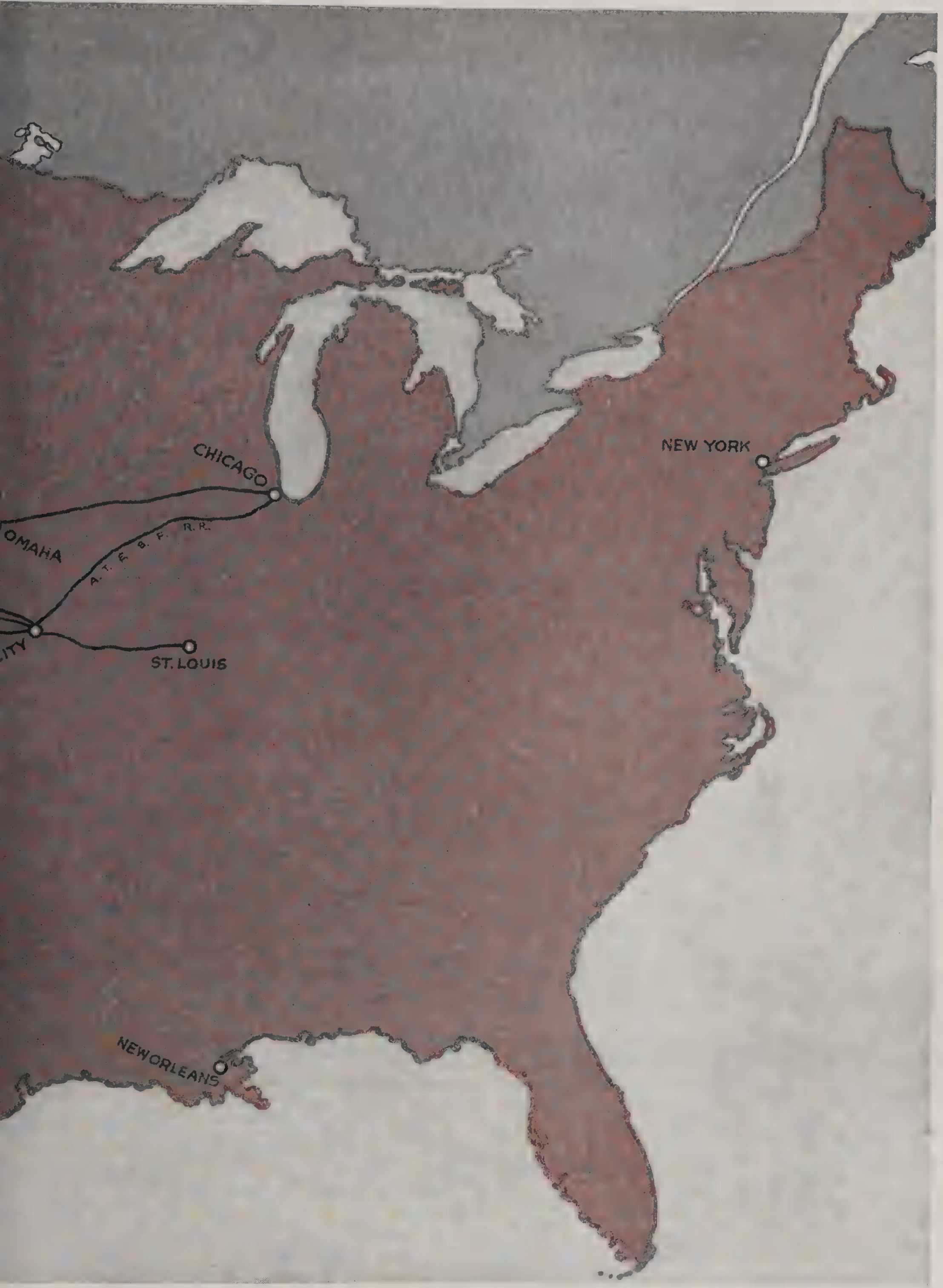
THE TUNNEL

KEY MAP ILLUSTRATING HOW COLORADO WAS LEFT IN A TRANS



"THERE EXTENDS ACROSS THE UNITED STATES THE GREAT BARRIER OF THE CONTINENTAL DIVIDE. . . . IN THE STATE OF COLORADO, FOR A DISTANCE OF THREE HUNDRED MILES, IS LOCATED THE MID-CROWN."

ION EDDY WHEN TRANSCONTINENTAL RAILROADS PASSED IT BY



"WHEN THE FIRST TRANSCONTINENTAL RAILROADS WERE BUILT RAPID PROGRESS AND ECONOMIC CONSTRUCTION WERE DETERMINATIVE FACTORS . . . AND [THEY] CHOSE THE LINES OF LEAST RESISTANCE."

PART THREE.

THE TUNNEL

CHAPTER I.

PUEBLO FLOOD OPENS WAY FOR CREATION OF TUNNEL DISTRICT—ACT PASSED IN SPECIAL SESSION OF STATE LEGISLATURE—COMMISSION APPOINTED—NOTABLE LEGAL VICTORY GAINED IN PROCEEDINGS TO TEST VALIDITY—BONDS SOLD AND CONTRACT AWARDED—OBJECTIVES OF MOFFAT TUNNEL REVIEWED—TERRITORY SERVED—THE DOTSERO CUT-OFF—DISTANCE AND ELEVATION REDUCED—ENGINEERING DETAILS OF THE WORK—OTHER GREAT TRANSPORTATION TUNNELS OF THE WORLD—THE WATER TUNNEL—DENVER'S PLANS FOR ITS USE.

AN act of providence, in the end, opened the way for construction of the Moffat Tunnel. The summer after defeat of the Tri-Tunnel bill the most destructive flood in the history of Colorado swept down the Arkansas River and, on June 3, 1921, covered the lower section of Pueblo with twelve feet of water. The inhabitants were at dinner when the siren of the local power company, blown only in cases of extreme emergency, began an incessant wail. Thruout the World War it had announced the triumph of American arms. On this day it proclaimed the mastery of Nature. To the thousands of anxious inquiries telephone operators replied: "A flood is coming down the Arkansas River."[209] Without a thought of the frightful havoc to follow, people flocked to the bridges and levees. About half-past eight o'clock a levee broke and the river roared thru the gap. There was a mad rush of spectators to a zone of safety. Pedestrians stumbled thru the dark streets; automobiles raced by, throttles wide open, horns blowing. On the heels of the retreating mob came the yellow flood, swirling thru the streets, tipping the lighter houses from their foundations, undermining business blocks, trapping man and beast. Suddenly the lights were extinguished as the waters drowned the electric generators. To add to the horror, a lumber yard near the city limits caught fire and the river carried the burning planks on its crest and lodged these fiery torches against the sides of houses. While torrents of rain fell the blaze spread from dwelling to dwelling. The lurid glare beat against an opaque sky, relieving the gloom, increasing the general terror.

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[209] Parker. *Pueblo's Flood in Picture and Story.*

Far out upon the mile-wide sheet of water houses could be seen afloat, bobbing crazily along. Leaning from windows or clustered upon roofs, in many instances, were human beings, men and women and children, who screamed and implored those on shore for aid. But no boat could remain afloat in that torrent. In addition to cloudbursts on the Arkansas and its tributaries above the city, similar phenomena occurred near Colorado Springs. A few hours after the attack of the main flood Fountain Creek overflowed, and Pueblo was divided by the waters into three sections. The residents rose the next morning to view a scene of unparalleled desolation and misery. Boats were secured from an entertainment park and rescuers rowed about searching for the marooned, the injured and the dead. Hundreds of refugees were to be cared for and fed. The domestic water system had been placed out of commission and recourse was had to wells and rain water. Those who had depended upon gas could cook no meals. Grocery stores were beseiged, for all communication with the outside world had been interrupted and none knew when it would be resumed.

Over six hundred houses were destroyed by the flood, while three hundred fifty more were so badly damaged that later they were condemned. The total property loss was estimated at sixteen million dollars, while the exact number of lives lost will never be known.[210]

With that courage characteristic of American cities that have been visited by natural disasters, Pueblo roused from the blow and began its rehabilitation on an ambitious scale. It soon became noised abroad that a plan had been devised so to harness the river that a calamity of like nature never could recur. To remedy a defect in the state statutes Governor Oliver H. Shoup was approached with the request that he call a special session of the legislature in order that a law might be enacted to permit the organization of flood conservancy districts.

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[210] Idem.

Advocates of the Moffat Tunnel immediately perceived that the situation offered a golden opportunity to press the issue for public construction of the tunnel. Support of Denver's city administration was readily enlisted and Mayor Bailey instructed City Attorney James H. Marsh to draft a bill which should make possible the formation of a tunnel improvement district to permit construction of the tunnel thru taxation of lands to be benefited. Denver, in 1914, had acquired by purchase the privately-owned domestic water supply system. Engineers of the municipal plant, looking forward to the time when the available supply from the South Platte River should become exhausted, already had investigated the possibility of diverting water from the Western to the Eastern slope of the Rockies and its incorporation into the city system. The tunnel plan, therefore, contemplated transportation of such a supply thru a separate water tunnel, which could be utilized during construction of the main bore to speed the operations.

These were the preliminary steps that resulted in the Moffat Tunnel Improvement District bill, drafted by Norton Montgomery, assistant who handled the water board's litigation in the city attorney's office, and Erskine R. Myer, also a member of the staff. Three months of investigation and research were required before the bill could be completed. It was based upon the same principles involved in creation of local municipal improvement districts and, as drawn, embraced the entire counties of Denver, Grand, Routt and Moffat, and parts of Jefferson, Adams, Boulder, Eagle and Gilpin counties. A bond issue of six million seven hundred twenty thousand dollars was authorized by its terms. No such physical difficulties as were encountered during construction were expected at this time, geologists having expressed the opinion that a solid core of granite existed at the selected point in the Divide, except for a short distance from the surface at each portal. While the bill conferred upon the commission the power to assess real estate for costs, it was hoped that contracts for use of the tunnel would pay both principal and interest on the bonds. Five commissioners were to be appointed, who were to have the dominant power of eminent domain.

Governor Shoup issued the call for a special session of the assembly April 8, 1922, limiting the subjects to be considered to the Moffat Tunnel bill and the Pueblo Flood Conservancy bill. In pursuance thereto the legislature convened on the eighteenth day of the same month. The Moffat Tunnel bill, introduced by Senator Fred S. Follett of Steamboat Springs, took its place upon the calendar as Senate Bill No. 1.

From the opening day of the session it was made apparent that the Tunnel measure was not to pass without a struggle. The opposition was political in nature, the debates acrimonious, the tension always at the snapping point. Pueblo representatives, vitally concerned with the passage of their own bill, offered no opposition to the companion measure and eventually voted for its passage. Objections to the tunnel came from El Paso, Fremont and other southern Colorado counties.[211] Valuable aid was rendered by a Chamber of Commerce committee composed of William G. Evans, Ex-Governor Elias M. Ammons and Ernest Morris, while Attorney Montgomery proved himself very adroit and resourceful in meeting the criticisms of opponents. The House of Representatives at one time actually adopted an amendment which eliminated the Commission and substituted therefor various boards of county commissioners of the principal counties included in the district. This point was one that nearly wrecked the chances of its passage, for opponents of the tunnel believed that they might nullify the act provided that a commission sufficiently unwieldy, or one composed of men opposed to the tunnel, were placed in charge of construction. Under existing conditions, it was almost a foregone conclusion that the bill would pass. When it became apparent that the defeat of one bill meant the defeat of both, wiser counsels prevailed and the Tunnel Act was passed by a combined senate and house

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[211] *The Colorado Magazine*, Morris. "A Glimpse of Moffat Tunnel History." Vol. IV, No. 2, 65.

Wm. P. Robinson

vote of seventy-six ayes against eleven nays.[212] Governor Shoup signed the bill May 12, 1922, and named as commissioners William P. Robinson, Charles MacAllister Willcox and W. N. W. Blayney of Denver; Charles H. Leckenby of Steamboat Springs, and Charles H. Wheeler of Yampa.

The Commission organized May 25th and elected Robinson as president, Willcox as first vice-president, Wheeler as second vice- president, Leckenby as secretary, and Blayney as treasurer.[213] Members and officers were sworn in by Chief Justice James H. Teller of the Colorado Supreme Court the same day and each commissioner posted a ten thousand dollar bond. Norton Montgomery was appointed general counsel, and Erskine R. Myer attorney for the Commission.

Under the terms of the act ninety days were allowed for protest. None having been filed within the allotted period, the Commission completed its real estate appraisal on July 17th.[214] Denver's share of the assessment was fixed approximately at eighty-nine per cent of the total district valuation. Her population constituted eighty-five per cent of the same.

Litigation was confidently expected and, since the bonds could not be sold until their legality had been established by court action, the Commission sought to hasten matters by having instituted a friendly suit. The plaintiffs, Mary L. Milheim and Frederick A. Metcalf, filed suit in the district court at Golden, Jefferson County, July 24, 1922. A permanent injunction to prevent the issuance and sale of bonds was asked. This action had the desired result and on August 3, 1922, the real opposition made its appearance in a petition in intervention, filed by the Wolfe Brothers Land Company, Torrence White, Sr., John S. Calkins, Laura E. Mingus, John R. Smith, and thirty-three others. Attorneys were Edwin H. Park, Barnwell Stuart and John R. Smith. Judge Johnson promptly denied the application and the case was taken to the Colorado Supreme Court. Litigation proceeded with astonishing rapidity, due to the diligence of the Commission's legal staff. The Colorado Supreme Court upheld the validity of the act in two decisions—one by Chief Justice Teller for the court, the other a specially concurring opinion by Justice George W. Allen.[215]

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[212] Distinguishing features of the Moffat Tunnel Act, aside from those previously mentioned, are: The tunnel, its approaches, equipment and appurtenances are to be owned in perpetuity by the Improvement District, and the tunnel is to remain forever a work for public transportation and communication. Monopoly by any persons or corporations is forbidden. The tunnel must remain an open gateway. Contracts for use may be made until capacity has been reached, for any term not in excess of ninety-nine years. Power, telephone, telegraph lines, water and rail transportation are included in the permissible uses. Bonds shall not bear interest in excess of six per cent, and the first issue can not be sold for less than par and accrued interest; shall be payable in not less than ten nor more than fifty years, and shall be free of state taxation. The Commission is empowered to construct power plants for electrification of the tunnel and, if revenues prove insufficient to retire bonds, pay interest and maintenance costs the Commission is authorized to assess real estate in the District. Three commissioners must be chosen who reside east of the Divide; two who live west of that line.

[213] William P. Robinson was for many years president of the Denver Union Water Company; Charles MacA. Willcox was a member of the Tunnel Commission created by Denver in 1913; Charles H. Leckenby, as editor of the Steamboat Pilot, was one of the earliest tunnel advocates, and W. N. W. Blayney took an active interest in the road for many years.

[214] The Commission fixed the value of District real estate subject to assessment as $298,544,996. Public utilities were appraised at $21,615,789. Denver's share of the assessment was $260,000,000.

The contest by this time evinced the usual bitterness that has accompanied all attempts to build the tunnel. The opponents were determined to take the case to the court of last resort, and, on January 10, 1923, the United States Supreme Court received the record. The vital points carried to the higher court involved the use of public moneys for a private enterprise, and the alleged violation of the Fourteenth Amendment to the Federal Constitution relating to confiscation of property without due process of law. On a motion to dismiss the writ of error Montgomery and Myer presented a convincing argument and, in a unanimous decision by the United States Supreme Court, the judgments of the lower courts were affirmed and the writ dismissed June 11, 1923.[216]

We have followed the legal history of the case thus closely because of the notable achievement involved. Within a period of eleven months, almost an unheard-of speed in a case of this importance, the Commission had carried a test case from inception thru three courts, receiving unanimous favorable decisions from the supreme courts of Colorado and the United States. In the meantime, the Commission had organized, accomplished important preliminary surveys and cleared the decks for construction. The outcome speaks volumes both for the attention of the Commission and the resourcefulness of the attorneys.

In less than two weeks after the United States Supreme Court decision had been received the Tunnel Commission sold the full bond issue of six million, seven hundred twenty thousand dollars to R. M. Grant & Company of New York.[217] They brought par plus a premium of two hundred fifteen thousand dollars.

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[215] Milheim v. Moffat Tunnel Improvement District, 72 Colo. 268 (1922), Judge Johnson denied the Milheim suit August 31, 1922; transcript of the record was filed in the Colorado Supreme Court, September 15, 1922; judgment rendered November 22, 1922.

[216] 262 U. S. 710 (1923).

Grant & Company bought every bond offered after the original sale and thus maintained the credit of the District at one hundred per cent; this in face of all previous difficulties and discouragements in relation to the Moffat Road and Tunnel. Without such prompt attention and protection the Commission hardly could have disposed of its later bond issues so easily and advantageously as it did. An idea of what this protection meant may be gained from the fact that the second and third issues, bearing five and one-quarter per cent interest, were sold readily, saving hundreds of thousands of dollars interest to the district. The attorneys who passed favorably upon these issues were Reed, Daugherty & Hoyt of New York, and Pershing, Nye, Fry & Talmage of Denver.

Seven days after the Commission had called for bids upon construction the members were faced by an election, under provisions of the act.[218] Engineers were placed in the field to make the final tunnel location, but before a spade had been placed in the ground, the first interest payment became due. A dangerous situation faced the Commission. Should it fail to "get underground" with the tunnel prior to the heavy fall snows, the entire winter then would be wasted, as it would be practically impossible to erect buildings, haul in and install heavy machinery and make favorable progress upon preliminary excavations at that high altitude. Without waiting for expiration of the period to advertise bids, and subsequent formalities, the Commission began construction of the portal camps during the summer, and started the open cut at West Portal August 25. The water tunnel was underground at West Portal September 12, and at East Portal October 13, 1923.

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[217] The bonds were sold June 23, 1922.

[218] First election of Commissioners was July 10, 1923.

The Board of Consulting Engineers included J. Vipond Davies[219] and J. Waldo Smith[220] of New York City, David W. Brunton[221] and Major L. D. Blauvelt of Denver.[222] R. H. Keays of New York was appointed chief engineer with the following assistants: Clifford A. Betts, office engineer; V. A. Kauffman, resident engineer, West Portal; Burgis J. Coy, resident engineer, East Portal. George Lewis, a practical mine superintendent, experienced in the Cripple Creek field, was named assistant to the president. Keays later resigned, and Kauffman was succeeded by James Cohig.

A tunnel survey over the hill had been made in 1922, but, when funds became available from the first bond issue the following year, the Commission, upon the advice of geologists, decided upon a new location in order to throw the West Portal four hundred feet to the south. The theory was offered that a certain projecting ledge would furnish solid rock for excavation, but the shift proved a delusion and was of no avail. The new location was offset from the line and grades run in 1922 by H. G. McMechen, as a recheck developed that this had been a remarkably accurate piece of work. Much romantic interest attached to this and subsequent surveys. To guard against possible error due to refraction of the sun's rays, the projected line into the tunnel was checked repeatedly against the surface line, under the direction of Betts, office engineer in charge of surveys. For night work powerful lights, permanently located at each portal, were used as sights, and long and short sights were taken. The engineers would leave the portal camps during the afternoon and make the steep ascent in time to arrive at the summit before dark. Conditions were best on cool nights. Permanent targets also were erected on either side of the broad summit, and from these positions sights were taken on the target lights far below in the valleys. Many a wild night above timberline was thus spent in checking and rechecking alignment. A small shelter house at an elevation of twelve thousand feet formed their only protection from the elements, and, on one occasion, a party escaped freezing by sitting before a wood fire all night, while a polar blizzard tugged at the frail cabin, and the mercury fell to forty degrees below zero.

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[219] John Vipond Davies is known as a railroad and tunnel engineer of wide experience, having designed and built tunnels under the Hudson River for the Hudson & Manhattan Railroad, constructed twenty-six aqueduct tunnels in Mexico, the Astoria Tunnel under East River, besides numerous other works of this character and importance.

[220] J. Waldo Smith is the eminent New York hydraulic engineer who, while chief engineer of the Board of Water Supply of New York City, constructed the Catskill supply system, which delivers five hundred million gallons of water daily by gravity to the five boroughs. Completion of the New Croton and Muscoot dams for the Aqueduct Commissioners of New York, the Catskill system and the eighteen-mile Shandaken Tunnel for the Board of Water Supply are among his notable achievements. Keays was the engineer in charge of the Shandaken Tunnel.

[221] David W. Brunton, internationally known mining and metallurgical engineer, built the Cowenhoven Tunnel at Aspen, the Roosevelt Tunnel at Cripple Creek, was engineer of underground connections for the Amalgamated Copper Company in Butte; invented the Brunton time-sampling machine, the Brunton transit; is an author of engineering works; has been consultant for European and South American mining companies.

[222] Major Blauvelt served as locating engineer on the Moffat Road; later became assistant chief engineer under H. A. Sumner, succeeding the latter as chief engineer. He is at present engineer of the Highway Department of the State of Colorado.

The Colorado Power Company, which was awarded the contract for furnishing power,[223] aided materially in this pioneer development period by constructing a power line up Boulder Canon from the plains to East Portal, a distance of seventeen miles, then crossing the Divide to West Portal, a distance of eight miles, all within a period of sixty days.

The contract for construction was awarded to Hitchcock and Tinkler and was signed by them and the Commission, October 19, 1923. The following day the work was formally placed under the contractors.[224] The contract provided that the tunnel was to be completed within forty-six months from the date that the document was signed, at the upset price of five million, two hundred fifty thousand dollars. If completed at less than the estimated cost the contractors were to receive fifty per cent of the sum saved, not including their fee of one hundred forty thousand dollars. For each day saved in time a bonus of one thousand dollars was to be paid, with a penalty of equal amount for each day over the contract time. Both the approaches were constructed by the Commission. An estimate of four hundred fifty thousand dollars was made for electrification. The unexpected extent of bad ground, which has made completion within the time limit impossible, prevents any conclusions upon final adjustment, so the contract need not be discussed further in this work. Since no saving was made in the estimated cost, the penalty clause did not apply.

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[223] This contract calls for the delivery of power in the form of three-phase energy at a frequency of approximately sixty-one and one-half cycles, and a potential of forty-four thousand volts. The current is stepped down by transformers to suit the various needs of operation. Agreement between the Moffat Tunnel Commission and the Colorado Power Company, August 7, 1923.

[224] F. C. Hitchcock, President, and C. C. Tinkler, Vice-President and General Manager of Hitchcock & Tinkler, Inc., have constructed some fifty tunnels during a period of twenty-eight years, including ten miles of pressure tunnels for the New York Board of Water Supply. From 1902 to 1904, in association with Geo. S. Good & Co., of which Hitchcock was manager and partner for thirteen years, they excavated thirteen tunnels on the Moffat Road, Hitchcock acting as manager and Tinkler as superintendent. They constructed six tunnels for the Burlington, fifteen tunnels for the Kettle Valley Railroad in British Columbia, six tunnels for the Tidewater Railroad in Virginia, one of which pierced the Alleghenies, and the eighteen-mile Hetch-Hetchy water tunnel for San Francisco, twelve miles of which were concreted. Both were associated with MacArthur Bros., when that world-wide organization built the Barker Meadow Dam at Nederland, Colorado, and a large dam at Creede. Tinkler constructed Camp Merritt for the government during the war. Hitchcock is director of the China Corporation, and vice-president of the Construction and Engineering Finance Company, which holds an interest in the Chester Concession in Turkey.

In order that the reader may have a better understanding of the advantages to accrue from the Moffat Tunnel a digression will not be out of place at this point. Aside from the service to be rendered a great undeveloped territory, there are two main objectives from the standpoint of railroad operation; namely, to save time by shortening distance, and to save motive power by lowering the mean elevation.

The territory to be served by the Denver & Salt Lake Railway, as projected to Salt Lake City, consists of a belt approximately one hundred miles wide, extending from that city to Denver. On the north this is bordered by the Union Pacific; on the south by the Denver & Rio Grande Western. West of the Continental Divide the subsidiary territory includes two geographical sections: Middle Park between the Divide and the Gore Range, included in the political subdivision of Grand County; the Uintah Basin, including Routt, Moffat and Rio Blanco counties in Colorado, and Uintah and Duchesne counties in Utah. The latter region constitutes the northernmost portion of the Upper Colorado River Basin. Middle Park is drained by the Colorado River, the Uintah Basin by Green River thru its tributaries, the White and Bear Rivers of Colorado and the Duchesne River of Utah.

For the most part Uintah Basin is a high, mountainous plateau, interspersed with narrow river valleys, and served only by the Moffat Road between Steamboat Springs and Craig, Colorado. The proposed railroad extension thru Vernal, Utah, will bisect the remainder of the Basin from Craig to Salt Lake City. The distance from Denver to Craig is two hundred fifty-five miles; the length of the projected line three hundred twenty-three miles. While this projection represents the true course of the Moffat Road, as originally conceived by Moffat,

Charles MacAllister Willcox

completion of the route may be delayed for many years because of the sparsely settled condition of the country. Only thirty-seven thousand inhabitants occupy the region immediately under discussion. The extension will be costly and the Moffat Road has been unable to finance it.

The Dotsero Cut-off, mentioned frequently during the course of this work, is an alternative proposition to place Denver and Salt Lake City upon a direct transcontinental route until such time as development of the Basin justifies the extension. The survey follows the Colorado River from Orestod, at the western end of Gore Canon, to Dotsero on the Denver & Rio Grande Western. The distance is forty-one miles, the grade less than one-half of one per cent. Construction of this short connection would make of the Moffat Road a thru line; or we might better describe the situation by stating that the Moffat Road would then become an open gateway instead of a stub line. The Dotsero Cut-off also would give the Rio Grande a short line to the Coast, in addition to fast express service to Denver for delivery of the bountiful fruit crops of Mesa and Gunnison counties. What the connection would mean from a railroad operating standpoint may best be shown by tables of distances and elevations.

The Union Pacific Railroad passes Denver with its main line one hundred six miles to the north. Salt Lake City occupies much the same relation to this road, but is adequately served to the west by the Oregon Short Line, the Southern Pacific, the Western Pacific and the Union Pacific to Los Angeles. The situation of Denver and the Uintah Basin is even more unfavorable when one turns to the Rio Grande. This line runs due south one hundred nineteen miles to Pueblo before it turns westward to follow the Arkansas River to Tennessee Pass. Here it crosses the Divide, descends Eagle River and again reaches the approximate latitude of Denver at the junction of the latter river with the Colorado. A huge bend, duplicating on a much smaller scale the roundabout ox-bow route of the old Overland Mail, is thus formed by the railroad. A table of distances will illustrate the disadvantage to which Denver and Northwestern Colorado are subjected.

DISTANCES FROM DENVER TO SALT LAKE

By the Union Pacific	628 miles
By the Denver & Rio Grande Western	745 miles
By the Denver & Salt Lake (via the projected Uintah Basin line)	578 miles
By the Denver & Salt Lake (via Dotsero)	572 miles

The saving in distance to be made between Denver and Dotsero by way of the Cut-off, as compared to the present operated line of the Rio Grande thus will be one hundred seventy-three miles. The Tunnel and Cut-off also will give a maximum grade of two per cent, eliminating the three per cent on the Rio Grande between Tennessee Pass, and Red Cliff on the Eagle River, if used by the Rio Grande.

The main Rio Grande line as now operated crosses two high summits between Denver and Dotsero. What these mean in train resistance and consequent higher motive power, may be appreciated thru a few comparisons in elevations, taking several basic points for the calculations. The railroad elevation at Denver is five thousand, one hundred ninety-eight feet; at Palmer Lake, seven thousand, three hundred twenty-seven feet; at Pueblo, four thousand, six hundred sixty-eight; at Tennessee Pass, ten thousand, two hundred forty feet; at Dotsero, six thousand, one hundred thirty feet. On the Moffat Road there is but one summit, the apex of the Tunnel, elevation nine thousand, two hundred thirty-eight feet. The Moffat Road survey ends at Dotsero at a slightly higher elevation than the Rio Grande, or six thousand, one hundred sixty-seven feet. We then have the following results:

TOTAL RISE ON THE D. & R. G. W. AND D. & S. L.—DENVER TO DOTSERO

Westbound		Eastbound		Total Rise
D. & R. G. W.				
At Palmer Lake	2,129 ft.	At Tennessee Pass	4,110 ft.	
At Tennessee Pass	5,572 ft.	At Palmer Lake	2,659 ft.	
D. & S. L.	7,701 ft.		6,769 ft.	14,470 ft.
Denver to tunnel apex	4,040 ft.	Dotsero to tunnel	3,071 ft.	7,111 ft.
Total saving in elevation on Moffat Road as compared to the Denver & Rio Grande Western				7,359 ft.

More than fifty per cent rise is saved by the Tunnel according to these figures.

Moffat Tunnel operation, as compared to the present Moffat Road line over Rollins Pass, will save approximately twenty-three miles in distance and twenty-four hundred feet in elevation, and will eliminate all grades over two per cent. Major Blauvelt is quoted as stating that the Tunnel also will avoid ten thousand eight hundred degrees in curvature on the present run over the hill; will reduce the maximum curvature from sixteen to nine degrees; and will eliminate the sections of fifteen degree curvature that hamper trains when moving above timber-line and across the snow-swept areas.[225]

The total length of the Moffat Tunnel is thirty-two thousand, eight hundred feet, or six and two-tenths miles. The grade is not uniform, sloping from the apex both ways to induce better drainage. East Portal is located at elevation nine thousand, one hundred ninety-six feet; West Portal at elevation nine thousand, ninety-eight feet. Both elevations are far below the Colorado timber-line, eleven thousand five hundred feet, and in a zone where no serious difficulty is caused by snow or wind. The distance from East Portal to the apex is fourteen thousand, fifty-four feet; the grade in this sector is three-tenths of one per cent. The distance from West Portal to the apex is eighteen thousand, seven hundred forty-six feet; the grades, of which there are two, are eight-tenths and nine-tenths of one per cent.

Among the great transportation tunnels of the world the Moffat Tunnel ranks in length with the Arlberg, which pierces the range of that name between Austria and France. Five other railroad bores have greater length, if we include the incompleted Cascade Tunnel on the Great Northern Railroad. While complete engineering data is not yet available from the Moffat and Cascade Tunnels for comparison with the work on completed tunnels, the following table will give an idea of these great works:

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[225] *Compressed Air Magazine*, Vol. XXX, No. 111, 1165.

PROGRESS AND COST OF SOME FAMOUS RAILROAD TUNNELS[226]

	Construction Period	Length, Miles	Duration Boring, Months	Av. Daily Progress of Headings, Feet	Cost per Lin. Ft.
Mt. Cenis	1857-1870	7.97	157	4.4	$356.00
Hoosac	1858-1874	4.75	-----	3.0*	398.00
St. Gothard	1872-1882	9.26	88	6.2	231.00
Arlberg	1880-1883	6.2	40	13.6	162.00
Simplon	1898-1905	12.4	78	13.69†	239.00
Loetschberg	1906-1911	9.3	54	14.2‡	211.00

*Average east and west headings, 1865-1873.
†Allowing only for days on which drilling was done, 17.45 per day.
‡Average for last thirty months, 17.1 feet.

As indicated by the table, the first great modern transportation tunnel was the Mt. Cenis, driven thru the northern spur of the Cottic Alps to connect the French and Italian railway system. From the date of inception until the headings met, thirteen years and one month passed. At the greatest depth below the surface, five thousand two hundred seventy-five feet, a rock temperature of eight-five degrees Fahrenheit was encountered. The compressed air-drill was first used in this tunnel. Total cost of the work was fifteen million dollars.

Construction began upon the Hoosac Tunnel in the United States one year after the Mt. Cenis bore was started. Altho the length was only four and seventy-five hundredths miles, sixteen years were required for completion, at a cost of ten million dollars.

Ten years were consumed in construction of the St. Gothard Tunnel, made possible by a joint treaty between Germany, France and Italy. The total cost was eleven million, three hundred thousand dollars. A zone of softened feldspar was encountered that made necessary granite walls and arches, six feet, seven inches in thickness. Loss of life was appalling. At a point five thousand, five hundred seventy-five feet below the surface the rock temperature was eighty-eight degrees Fahrenheit. Eight hundred lives were lost during construction.

By this time great improvement had been made in tunneling ma-

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226. Brunton & Davis, *Modern Tunneling*. The same authority is used for succeeding data on large transportation tunnels of the world.

chinery so that when Austria desired a tunnel connecting that country directly with France it was possible to accomplish double the average progress per day on the Arlberg as compared to the St. Gothard Tunnel. The cost of this work was five million, eight hundred seventy-seven thousand, six hundred eighty-four dollars, and the headings met three years and four months after construction had started. Rock conditions were very favorable thruout construction.

The Simplon Tunnel between Switzerland and Italy, longest transportation bore in the world, marked another innovation. Difficulties were more varied and serious than in any other tunnel ever constructed with the exception of the Moffat Tunnel. Swelling ground was extremely common. As in the case of the Moffat Tunnel, steel I-beams were required to hold the roof and sides and, where the pressure was greatest, the cost is said to have been one thousand six hundred dollars per linear foot. To add to the difficulties many hot springs were cut, the flow totaling four thousand, three hundred thirty gallons per minute at one hundred degrees Fahrenheit. Six months were required to drive the last eight hundred feet. Because of the hot water the idea of driving a parallel tunnel was adopted, this enabling the engineers to introduce quantities of cold air and water in order to lower the temperature. Two single tracks, parallel to one another, resulted. Five years and two months passed before the tunnel was ready for operation, and the total cost was fifteen million, seven hundred thousand dollars.

The Loetschberg Tunnel, driven thru the Bernese Alps, was completed in five years. The first tunnel started caved for five thousand, nine hundred feet when workmen opened an immense underground peaty bog. Twenty-five men were killed in the accident. To avoid this difficulty, a second tunnel, laid out on a curve, was driven.

The early American record for hard-rock drilling, nine hundred thirty-two feet in the west pioneer tunnel in one month, was made during construction of the Rogers Pass Tunnel on the Canadian Pacific Railroad, thru the Selkirk Range in British Columbia. This record stood until the distance was bettered in construction of the

Moffat Tunnel bore. The center heading method was used at Rogers Pass, and exceptionally favorable rock conditions prevailed thruout. Only sixteen hundred feet of softened rock, none of which was as serious as that found in the Moffat Tunnel, were encountered during the five-mile construction. In this work, the pioneer tunnel, an adaptation of the Simplon, came into being, solely for the purpose of speeding operations in the main tunnel by means of cross-cuts and inside headings. Methods employed were much the same as in the Moffat Tunnel, with the exception that the latter work contemplated the use of the supplemental bore as a conduit to carry water.

While the Cascade Tunnel on the Great Northern Railroad will eliminate only six hundred feet in elevation, and save only seven and sixty-seven hundredths miles in distance, its justification lies in reduced grades and the elimination of more than six miles of snow sheds.[227]

The Moffat Tunnel is the first work of similar magnitude designed as a joint transportation and water carrier. The idea of diverting water from the Western Slope for use in Denver's domestic water system originated as far back as 1913, when Denver adopted by popular vote the charter amendment for joint construction of the tunnel by the city and the railroad.[228] At that time it had been intended to bring water thru the transportation tunnel, but later engineering advice was strongly opposed to such an experiment.

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[227] *Engineering News*, January 7, 1926, 28.

[228] Active work in contemplation of Western Slope water diversion was begun by the Public Utilities Commission of Denver, now defunct, when Ralph Meeker, a hydraulic engineer, was employed to make surveys on Williams Fork, Fraser and Blue rivers. Work was started March 21, 1914. This was followed by investigations and reports of other engineers, including Van Sant and Houghton of San Francisco. When the Municipal Board of Water Commissioners assumed control of the city plant the problem was placed in the hands of George M. Bull, hydraulic engineer of Denver. Detailed surveys were made in 1921, filings were prepared on the Fraser and Williams Fork rivers, and these were recorded in the office of the State Engineer and the General Land Office in Washington. Similar surveys and filings were made on Blue River the following year. All these appropriations date back to March 21, 1914, when the first actual work was done by the Utilities Commission. Since 1920 the Board of Water Commissioners has constantly maintained an appropriation for investigations, surveys and preliminary work as required in final development of such projects. These studies resulted in adoption of a plan for water development. The total amount of water available, and its sources, may be summarized as follows: Fraser River—Covers all streams that form the main river above an approximate elevation of nine thousand feet, including Ranch Creek, James Creek, Elk and St. Louis creeks. The drainage area above the points of diversion is one hundred square miles, and the annual run-off 106,000 acre feet. Williams Fork could furnish an average of 50,000 acre feet per year, and Blue River could supply 100,000 acre feet. Each project is independent of the others, and the construction of one in no wise alters the cost of the others. The first development stage would involve construction of laterals from James Creek and Ranch Creek to the tunnel, supplying 30,000 acre-feet per year. The second stage is represented by a plan for a canal northerly to the Ranch Creeks, and would add 11,000 acre-feet. The third stage involves a canal system constructed in a southwesterly direction from Fraser River to Vasques Creek, which would give a total diversion for three stages of 65,000 acre-feet. The fourth stage would mean the reconstruction and enlargement of the entire canal system from the tunnel to Vasques Creek, with an extension to Elk and St. Louis Creeks, completing the maximum development of the Fraser River project. To install the first three stages it would be necessary to enlarge and line the water tunnel to the summit of the west side, and make minor repairs on the east side. Should the fourth stage be installed the tunnel would have to be enlarged and concreted on the eastern side. Paralleling, and in connection with bringing the water thru, it would be necessary to build conduits and canals on the eastern side in order

The city plans eventually to divert two hundred fifty thousand acre feet of water from Western Slope sources to the east side of the Divide, including projects in connection with the Fraser, Blue and Williams Fork rivers. The only project for which the Moffat Tunnel could be used is that of Fraser River, from which a total of one hundred six thousand acre feet could be diverted. Development of this may be made in four stages at a total cost, including incorporation of the water into the city system, of seven million dollars—in addition to the amount already spent upon the water tunnel in construction. Thirty thousand acre feet, sufficient to hold the city's rights until complete development is made, could be brought thru the tunnel for one million, two hundred twenty-five thousand dollars, in addition to the amount spent upon the water tunnel during the construction period.

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to incorporate the water into the city system. The cost involved in connection with the water tunnel, in addition to the amount spent upon it to date, would be $1,150,000, which, however, would take care of the first three stages. There would also be an expenditure for canals of $60,000 on the first stage, $335,000 on the second stage and $660,000 on the third stage. Enlargement and construction of new canals from the tunnel to St. Louis Creek, involved in the fourth stage, would cost $1,400,000. At that time $700,000 would have to be spent to enlarge and line the eastern side of the water tunnel. In order that the water might be incorporated in the Denver water system, $3,000,000 would have to be expended. The total expenditure for completion of all four stages and incorporation of water into the city system, in addition to the amount spent in construction of the tunnel, would be $7,000,000. It should be remembered, however, that the work necessary for bringing 30,000 acre-feet thru the Divide, or the first stage of the Fraser River development, would start perfection of water right, and nothing further need be done until it becomes necessary to perfect the water right and use the water in Denver. Until that time the water transported thru the tunnel could be turned into South Boulder Creek and used temporarily for irrigation. To carry out this first stage would require $1,225,000 above the amount already expended upon the tunnel. The cost of this last mentioned work to a five-thousand-dollar home in Denver would be about $28.00 with interest charges amounting to seventy-seven cents per year. (Statement of George M. Bull to the writer.)

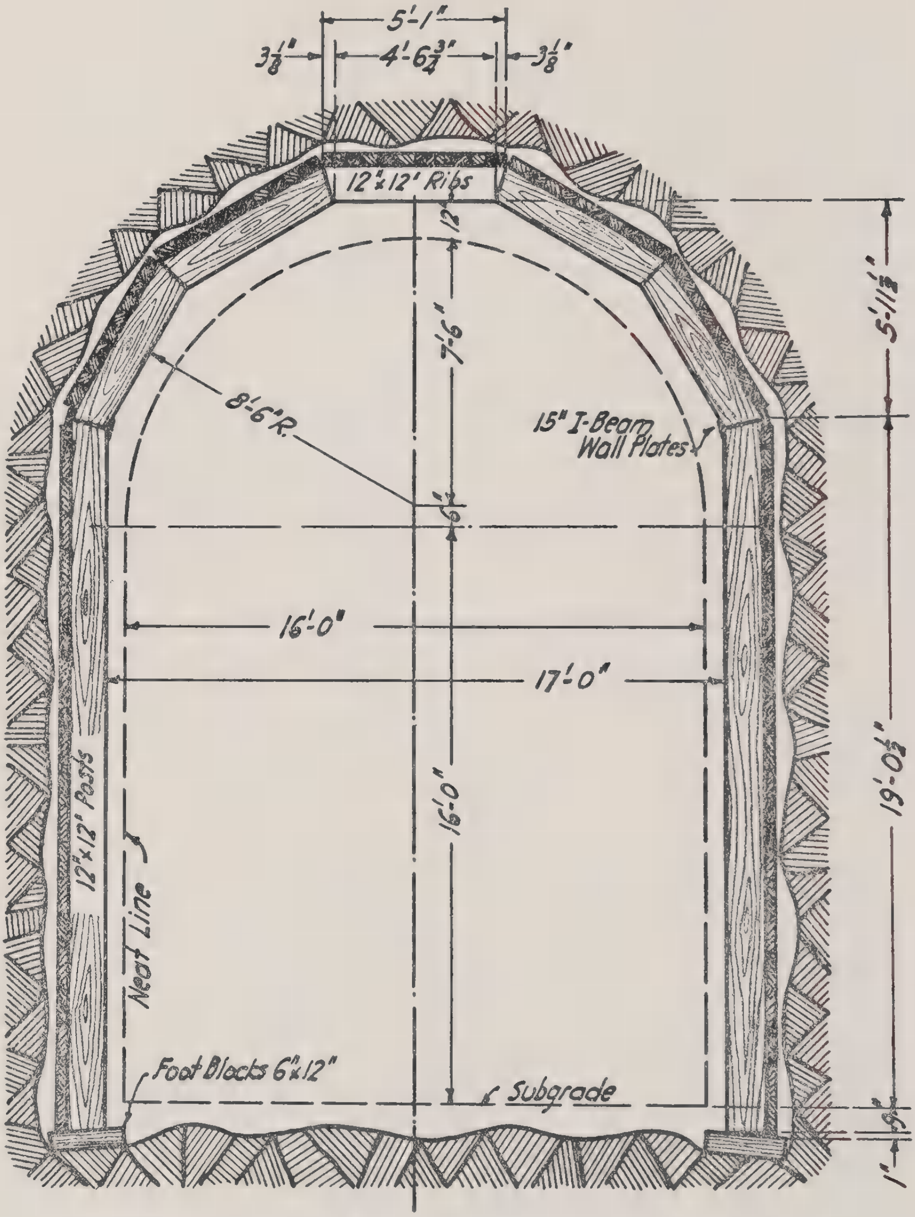
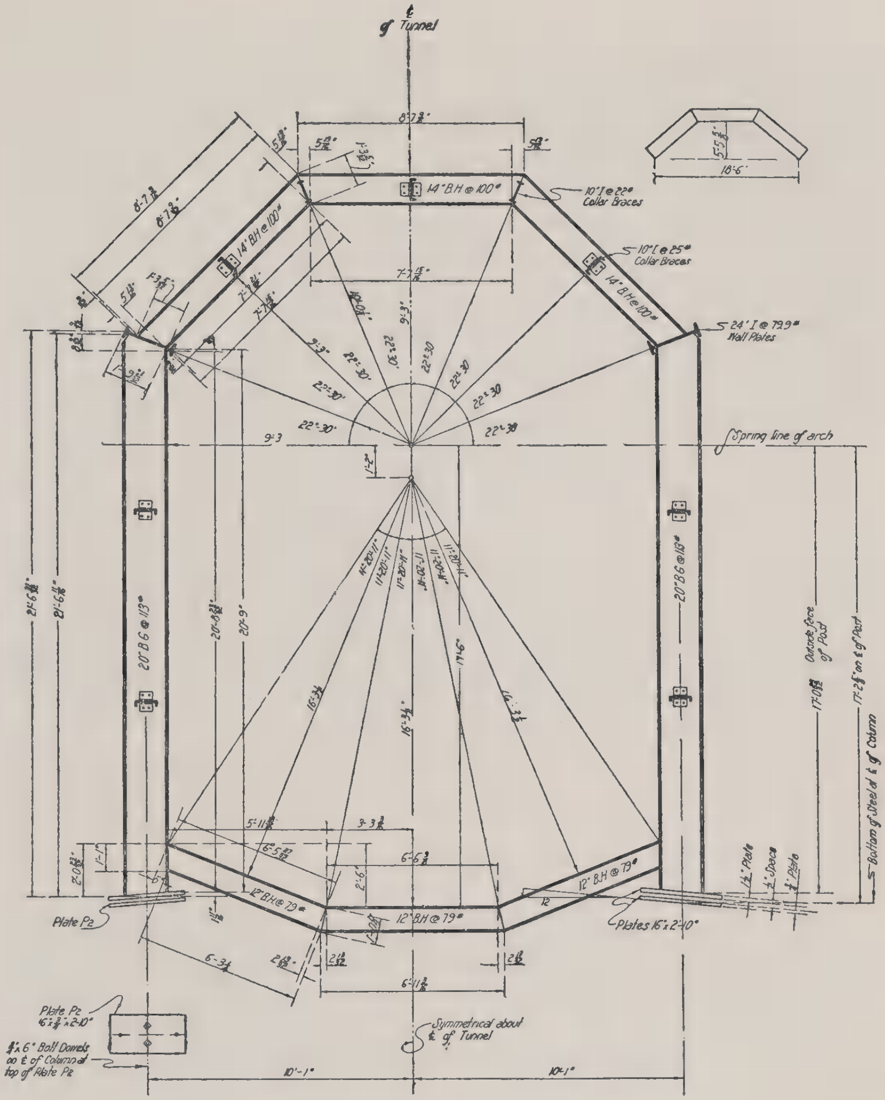


DIAGRAM OF COMPLETED (16x24-FOOT) RAILROAD TUNNEL FULLY TIMBERED



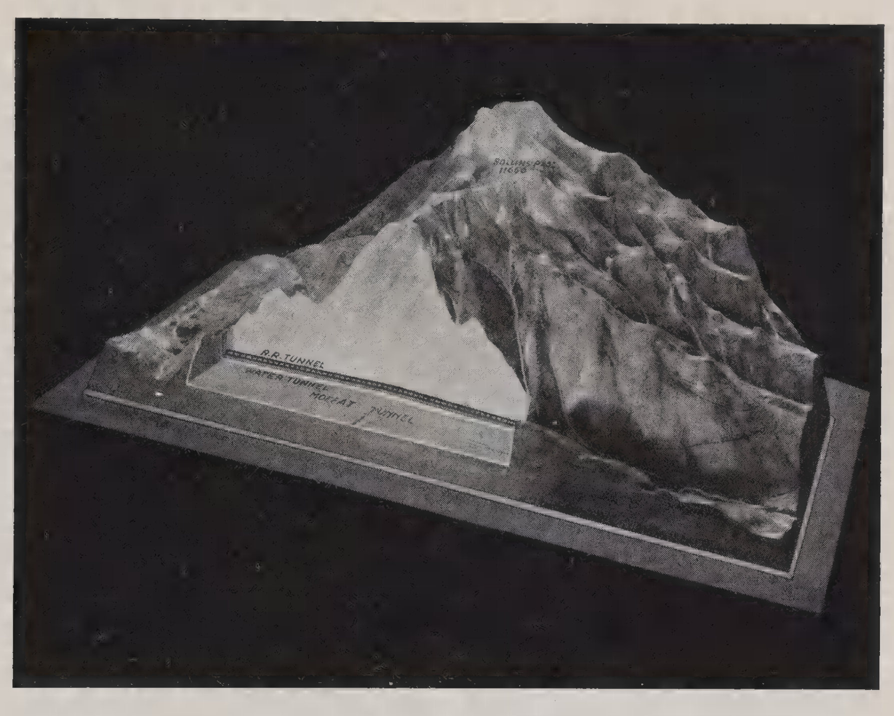
END · ELEVATION ·

Scale ¼ inch = 1 foot

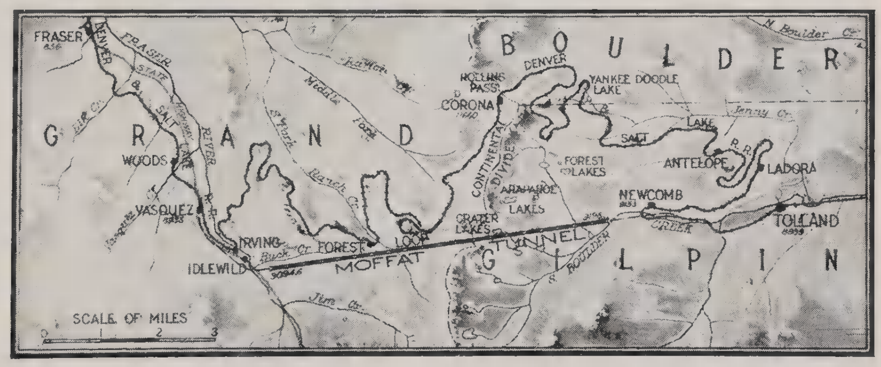
·HEAVY · STEEL · SETS·

·MOFFAT · TUNNEL · COMMISSION · 1927·

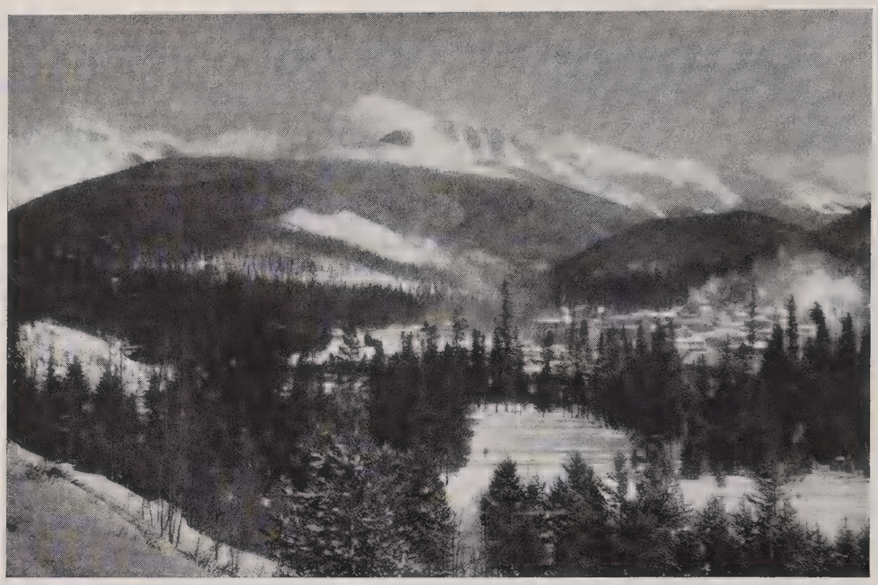
DIAGRAM OF HEAVY STEEL SETS AND INVERTS UTILIZED IN SOFT GROUND



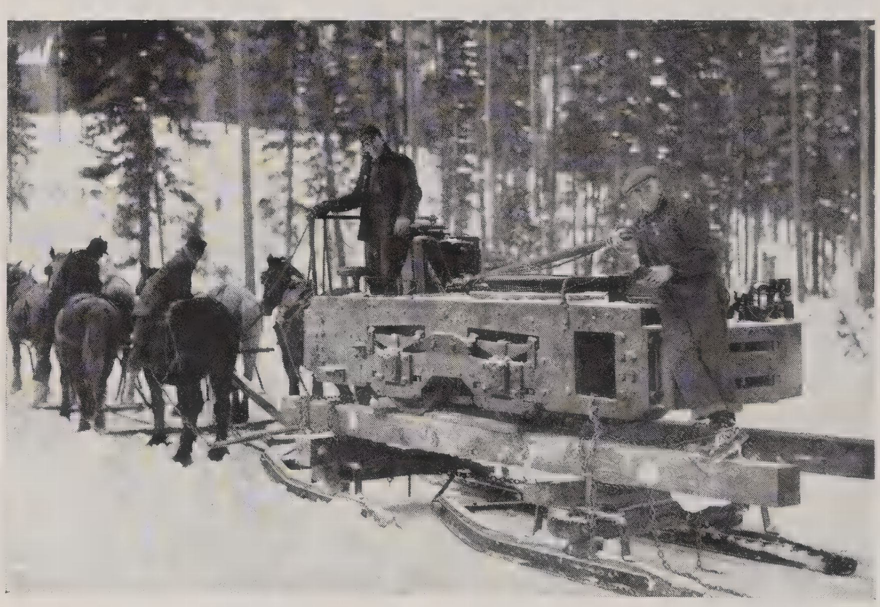
DIVIDE MODEL AND TUNNEL CROSS-SECTION BASED ON ENGINEER'S PROFILE



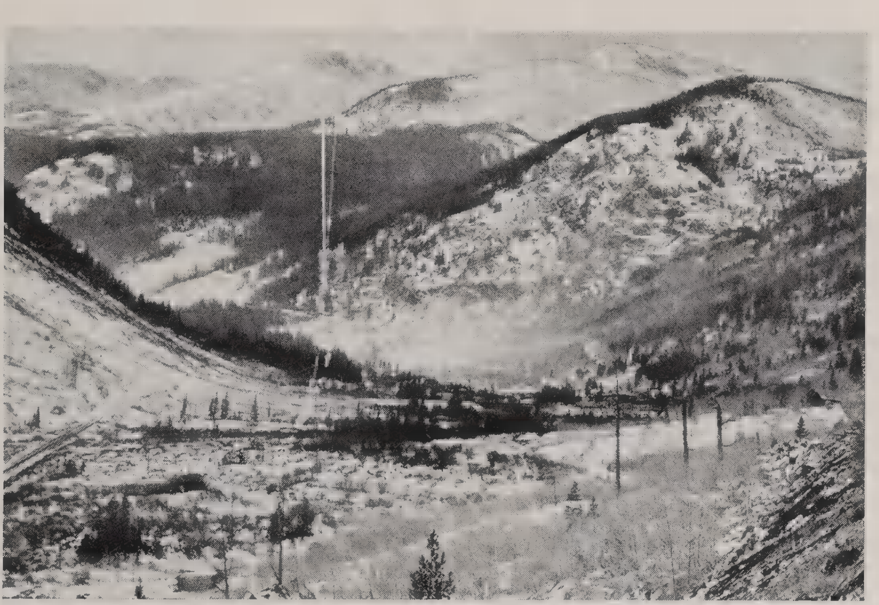
HOW TWENTY-THREE MILES OF RAILROAD WERE ELIMINATED BY THE TUNNEL



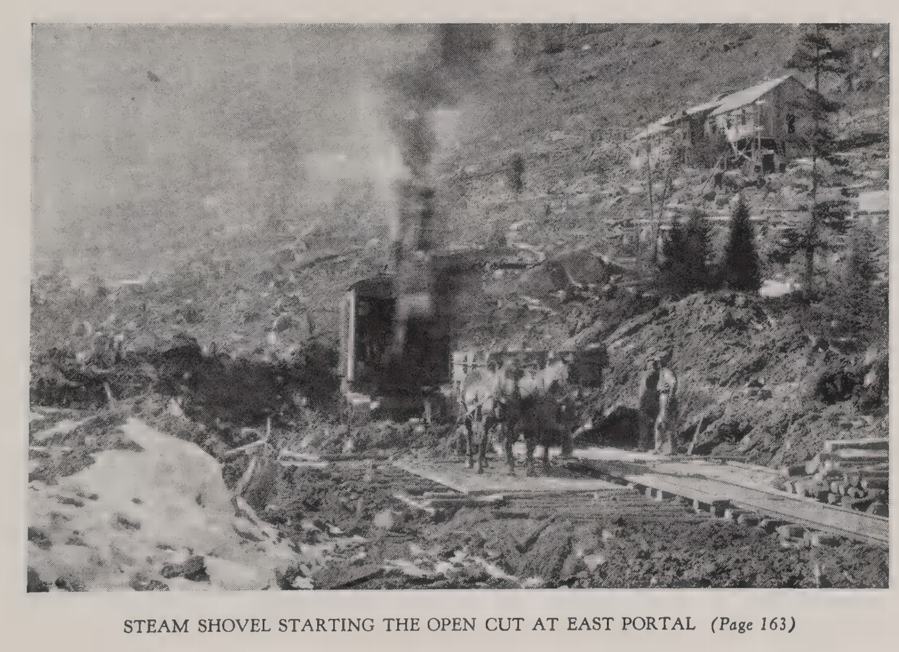
THE CONTINENTAL DIVIDE AND WEST PORTAL CAMP IN THE WINTERTIME



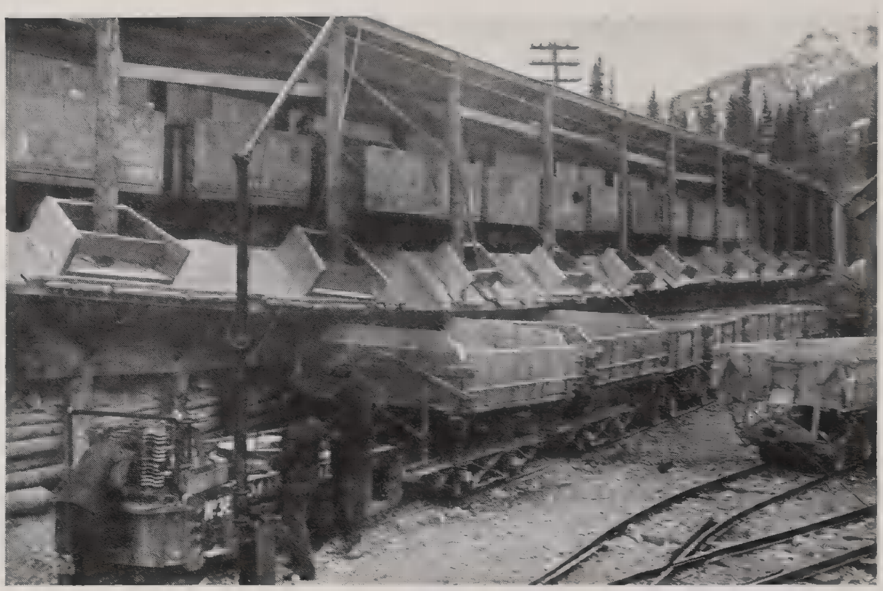
HAULING PLANT MACHINERY BY SLED FROM WEST PORTAL RAILROAD SPUR



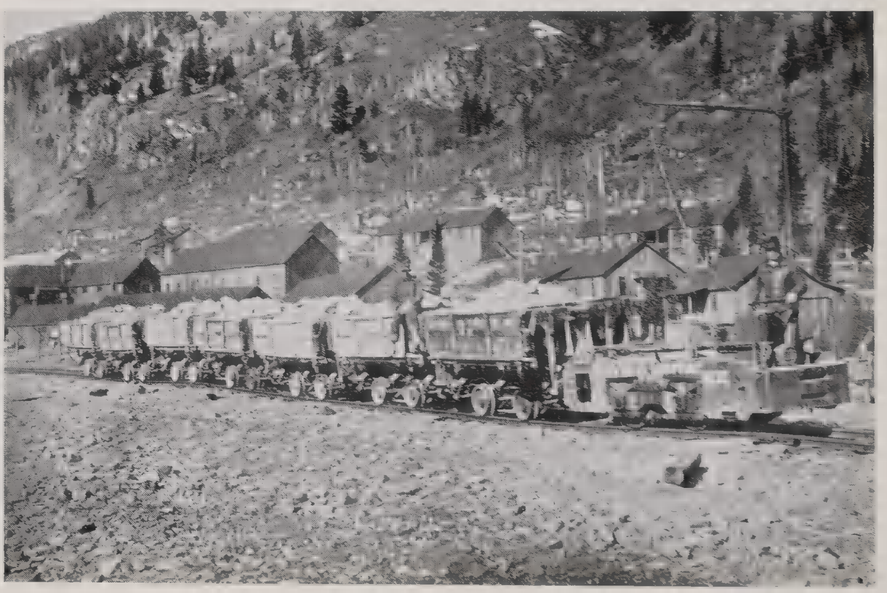
SURVEY LINES THRU EAST PORTAL TIMBER—HEAVY LINE TUNNEL LOCATION



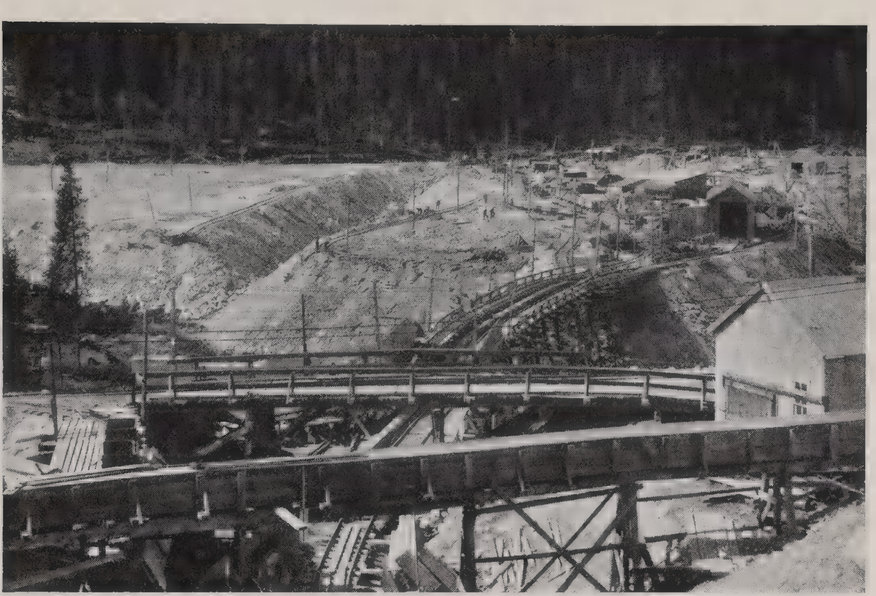
STEAM SHOVEL STARTING THE OPEN CUT AT EAST PORTAL *(Page 163)*



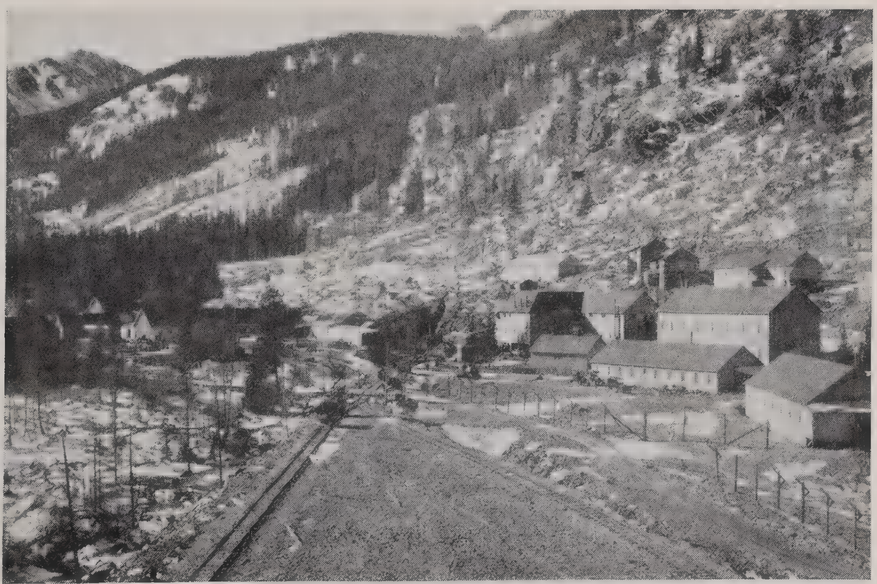
TRANSFER DOCK FOR UNLOADING FROM WATER GRADE TO RAILROAD GRADE



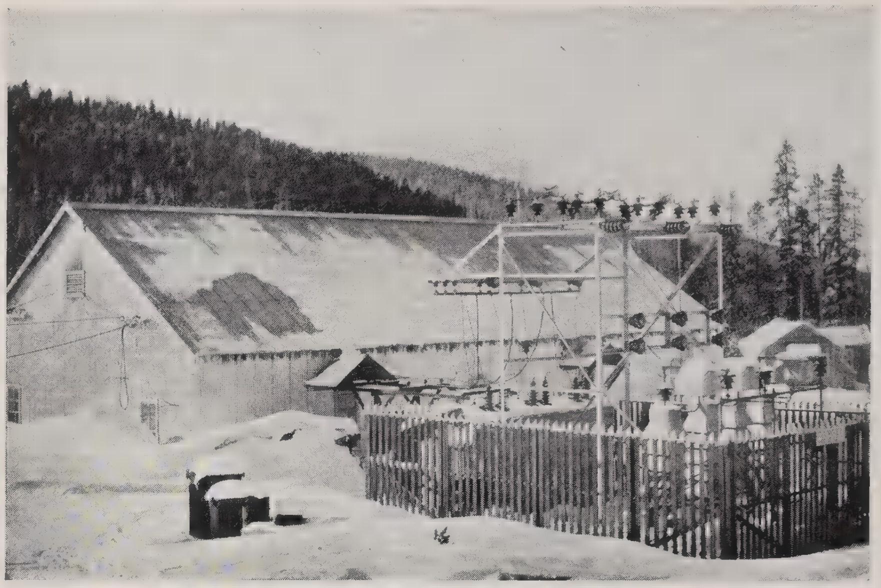
HAULING A LOAD OF MUCK TO THE DUMP FORMING RAILROAD APPROACH



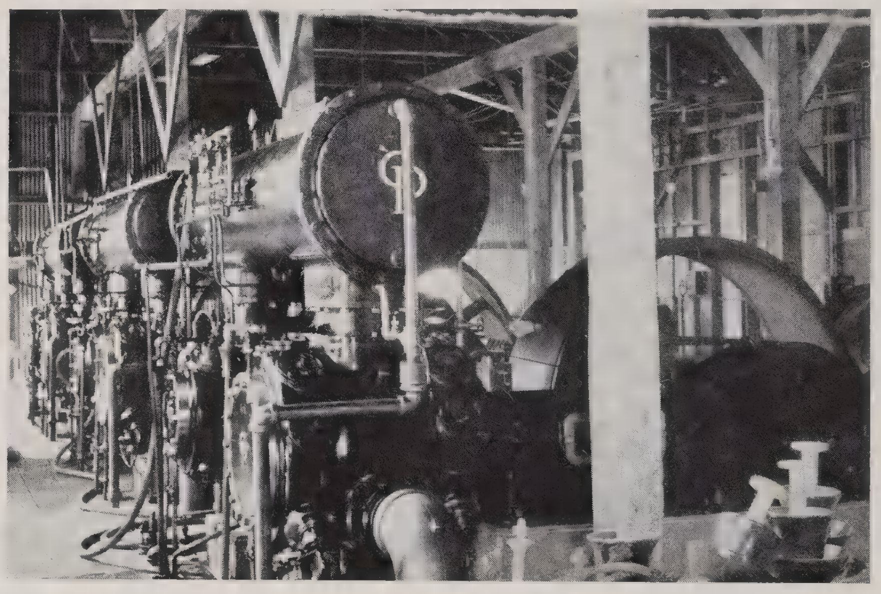
WEST PORTAL APPROACH ON THE FRASER RIVER BED SETTLED FIFTY FEET



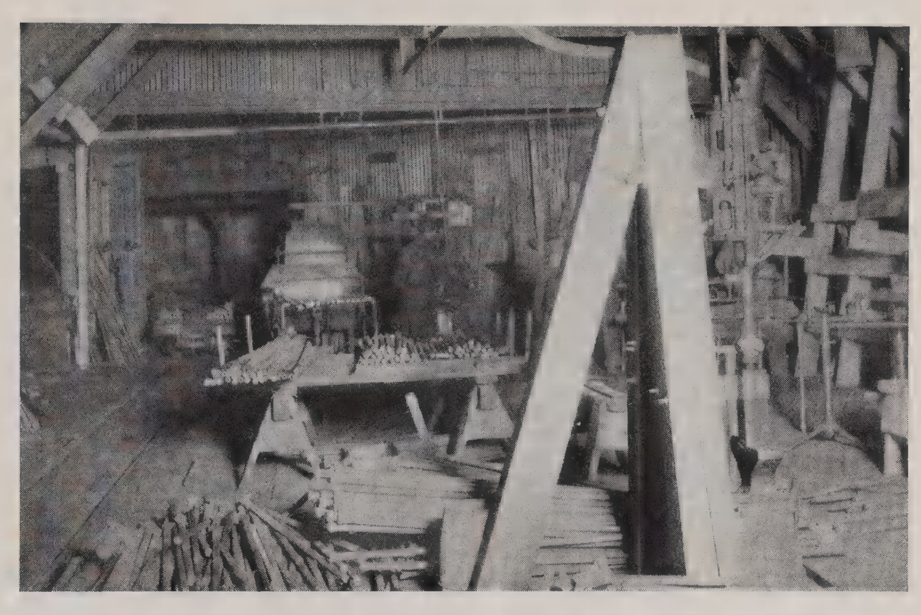
THE CAMP BUILDINGS AT EAST PORTAL AND GRADE FOR THE RAILROAD



THE ELECTRICAL TRANSFORMER PLANT AND POWER HOUSE AT WEST PORTAL



COMPRESSOR PLANT AT EAST PORTAL THAT FURNISHED HIGH-PRESSURE AIR

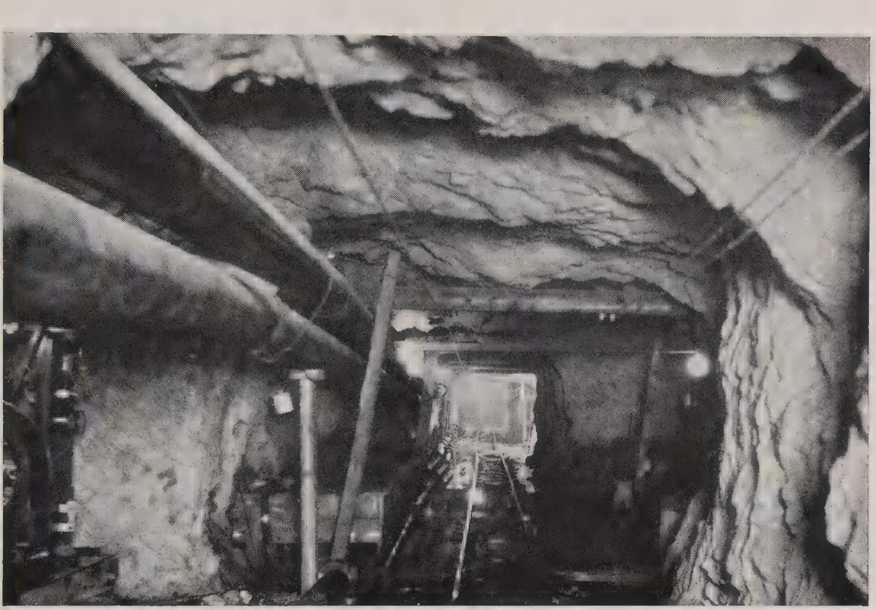


STEEL SHARPENING PLANT, EAST PORTAL, WHERE DRILLS WERE SHARPENED

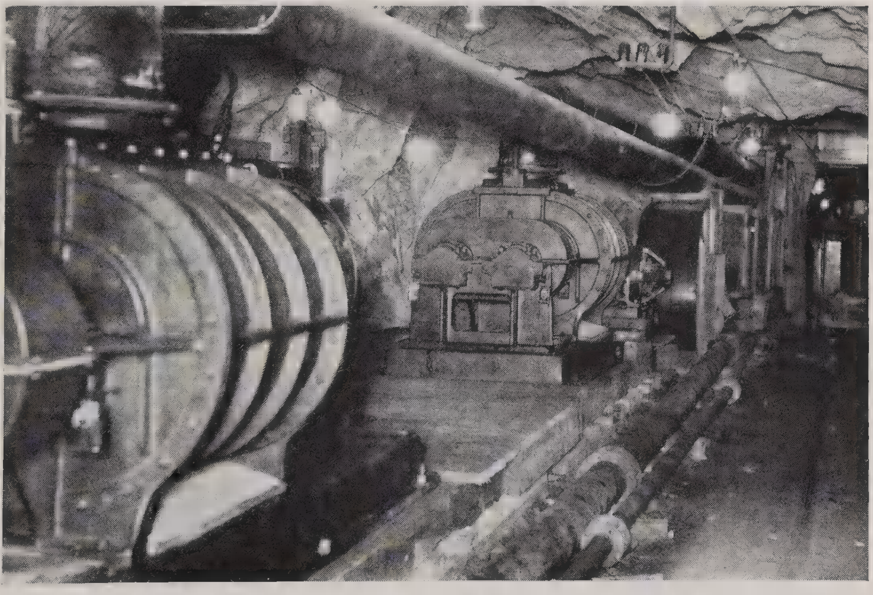
MACHINERY WAS KEPT IN A HIGH STATE OF EFFICIENCY ON CONSTRUCTION

VENTILATING DOORS OPEN ON CROSS-CUT FOUR, EAST PORTAL *(Page 216)*

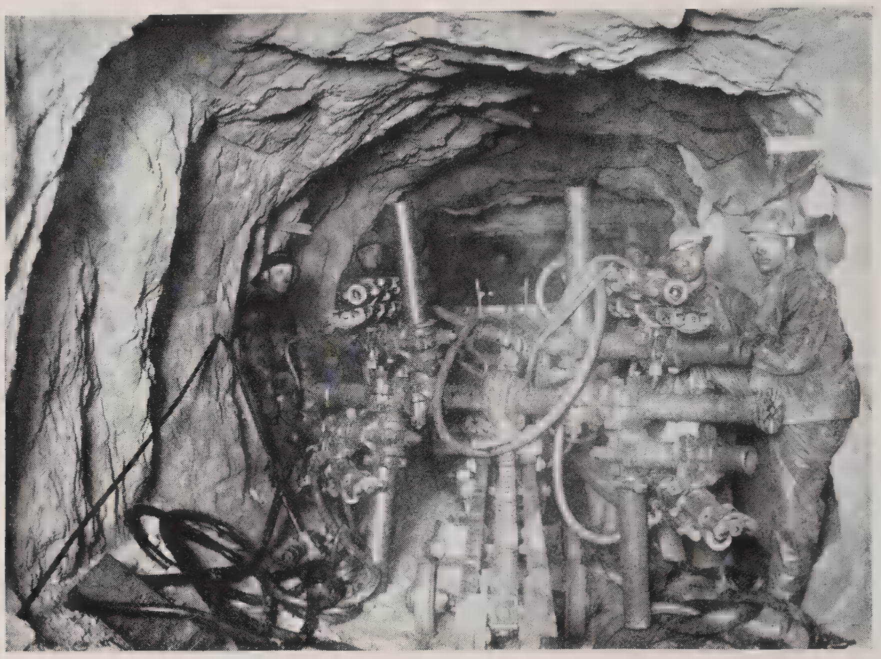
BUFFALO FANS FURNISHED LOW-PRESSURE AIR TO HEADINGS *(Page 217)*



MOTOR GENERATOR SET AND LUNCH BENCH IN EAST PORTAL WATER TUNNEL

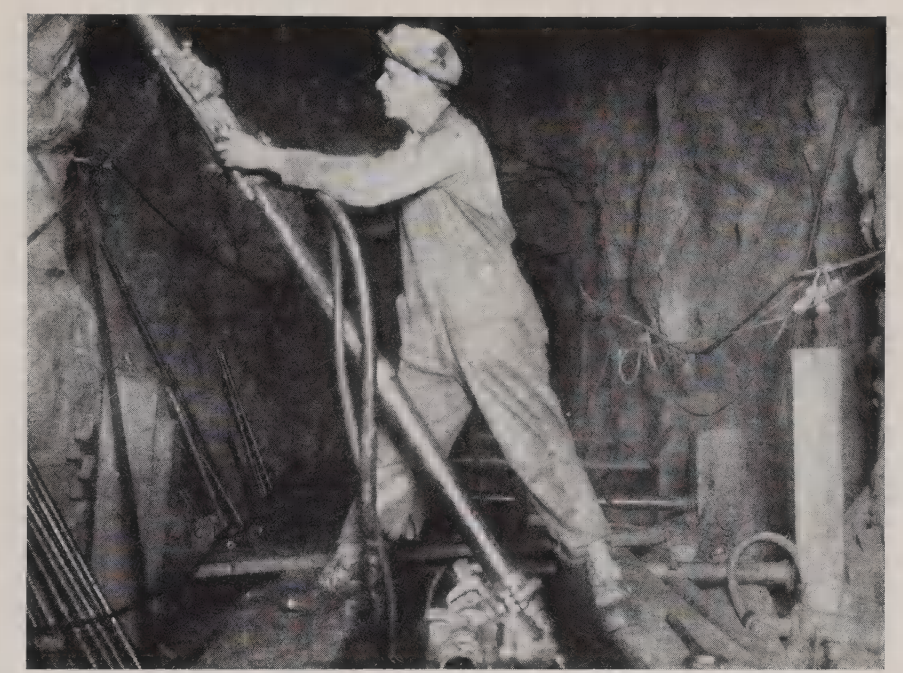


THE BIG VENTILATING BLOWERS SET UP ONE MILE IN FROM EAST PORTAL

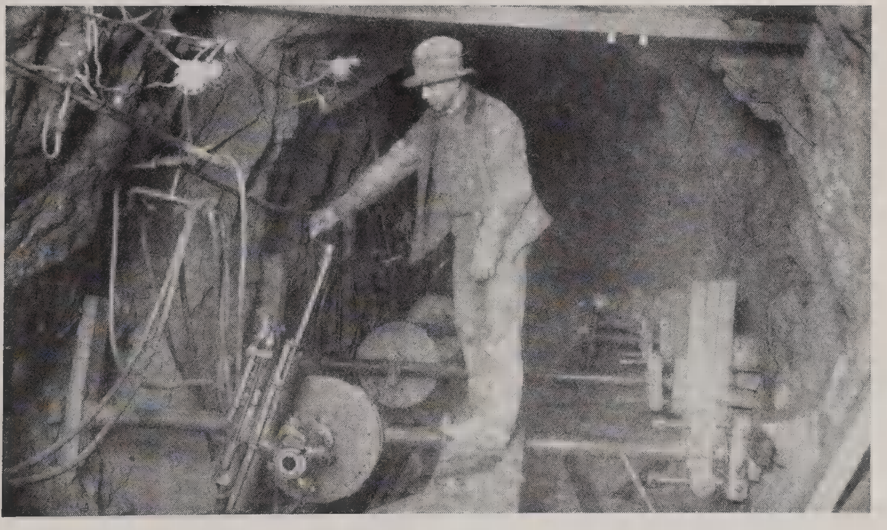


DRILL CARRIAGE, MOUNTING FOUR DRILLS, FOR RING-DRILLING OPERATIONS

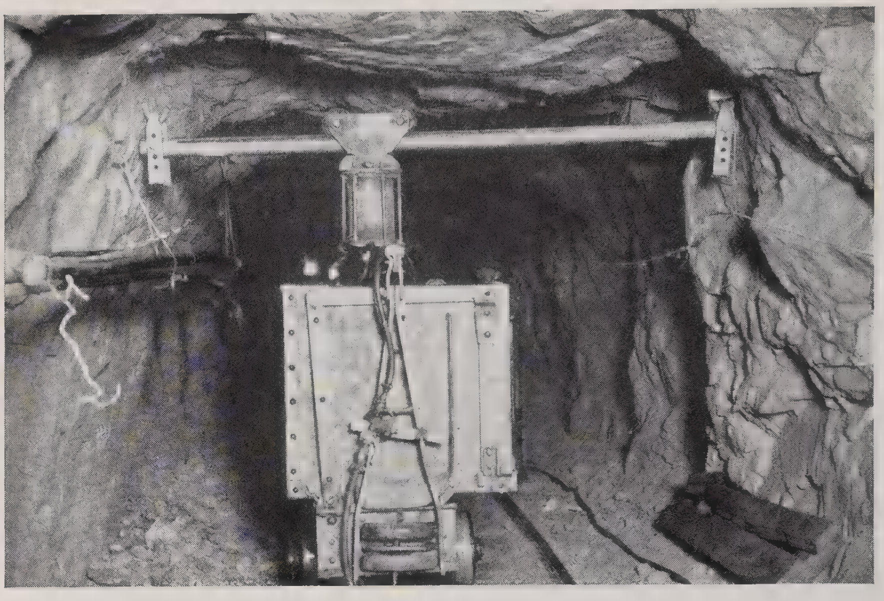
DRILL-DOCTOR, ONE AND ONE-HALF MILES UNDERGROUND FROM EAST PORTAL



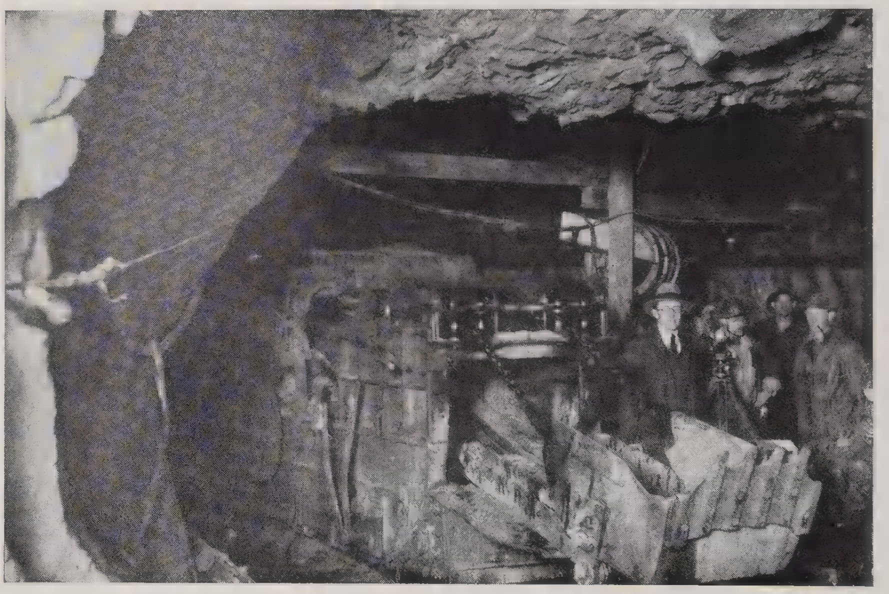
STOPING IN RING-DRILLING OPERATIONS FOR THE RAILROAD ENLARGEMENT



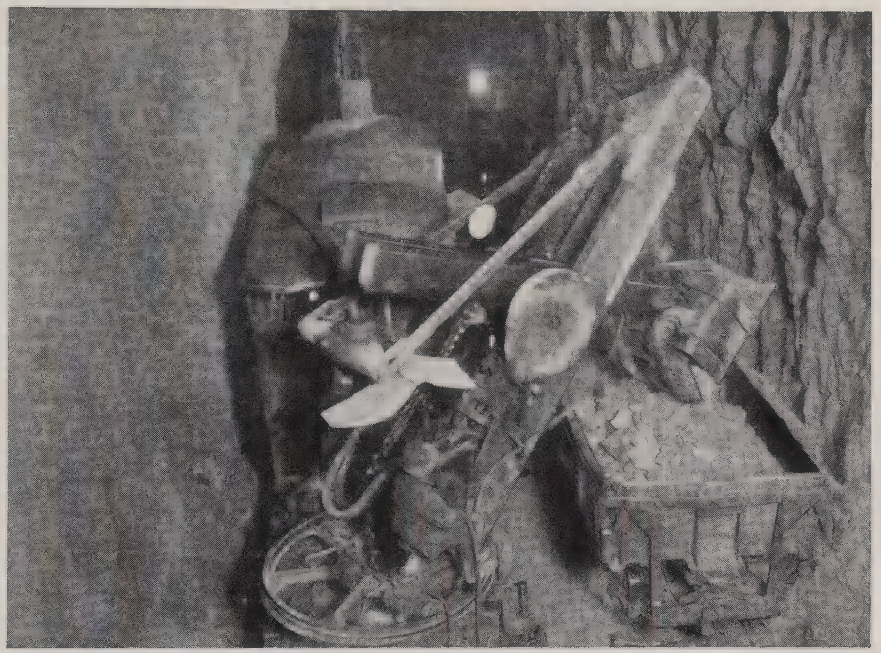
DRIFTING IN RING-DRILLING OPERATIONS FOR THE RAILROAD ENLARGEMENT



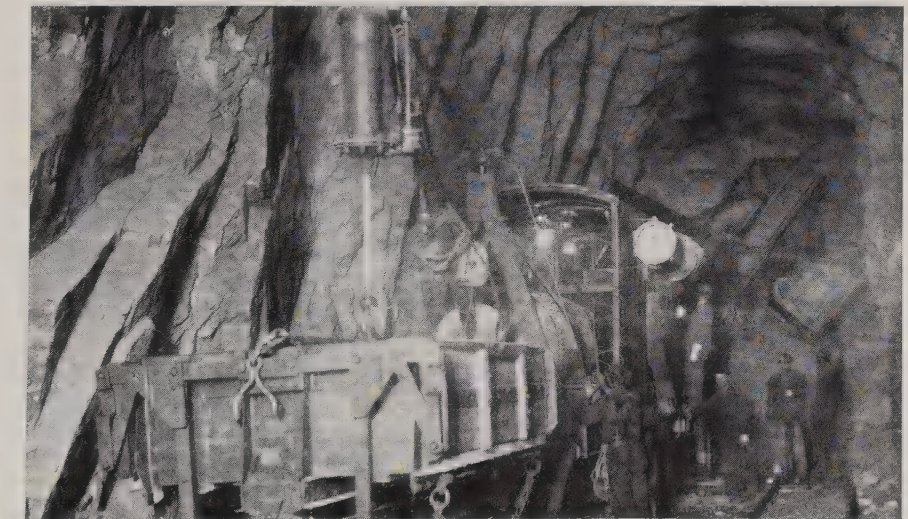
ALLEN AIR-HOIST CAR SHIFTER, INVENTED ON THE MOFFAT TUNNEL JOB



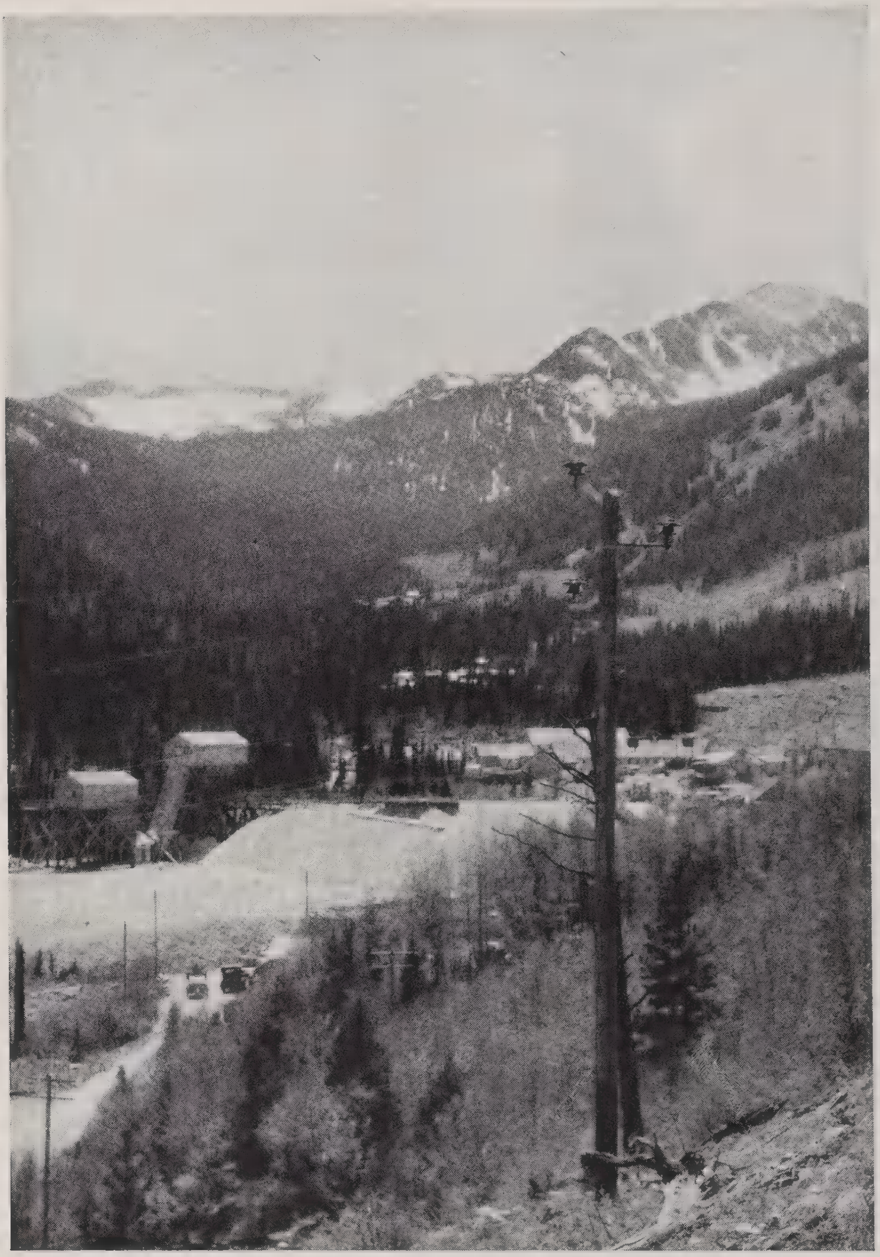
THE CONWAY MUCKING MACHINE, USED IN THE TUNNEL HEADINGS *(Page 217)*



OSGOOD AIR-SHOVEL, WHICH WAS USED ONLY IN MAIN TUNNEL ENLARGEMENT

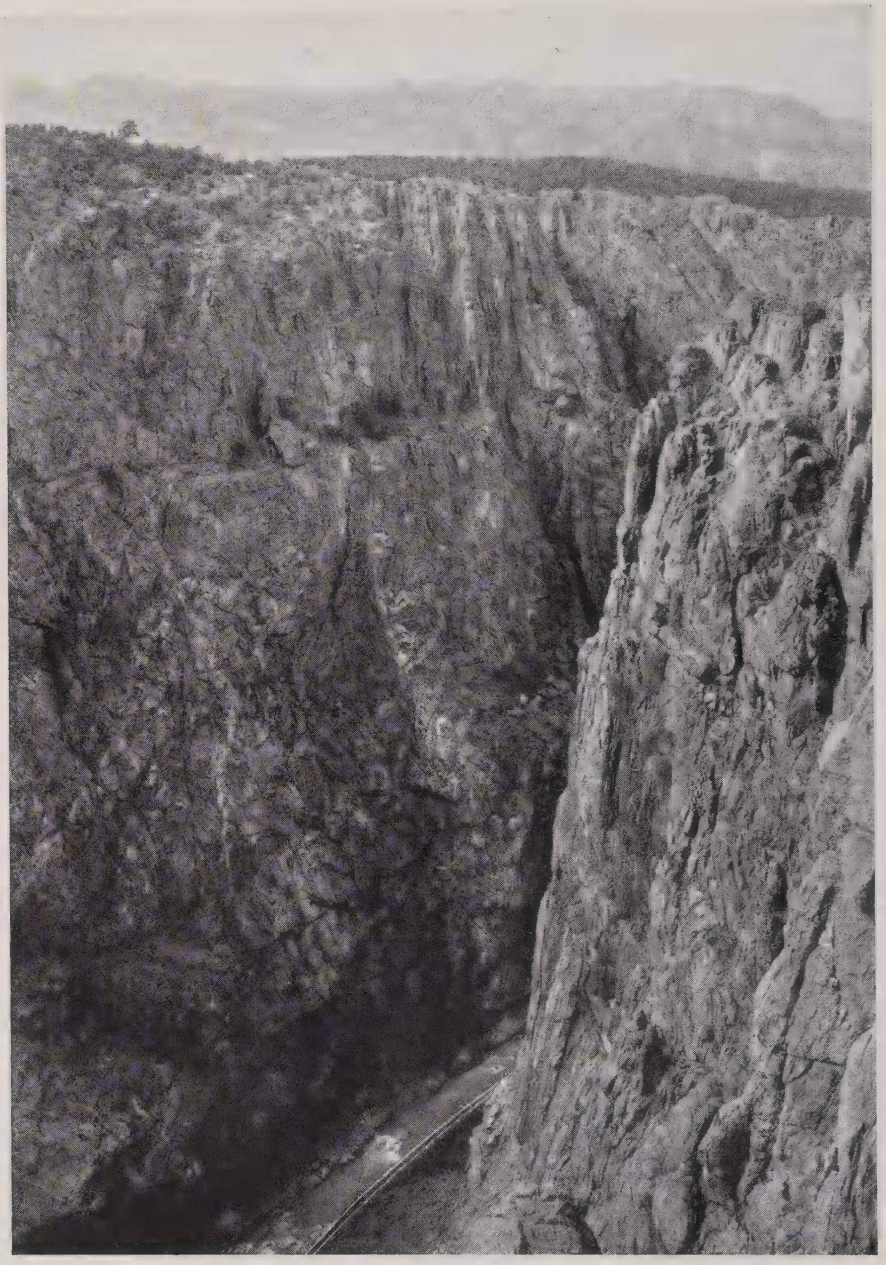


AIR-SHOVEL LOADING FOUR-YARD CARS IN RAILROAD TUNNEL ENLARGEMENT

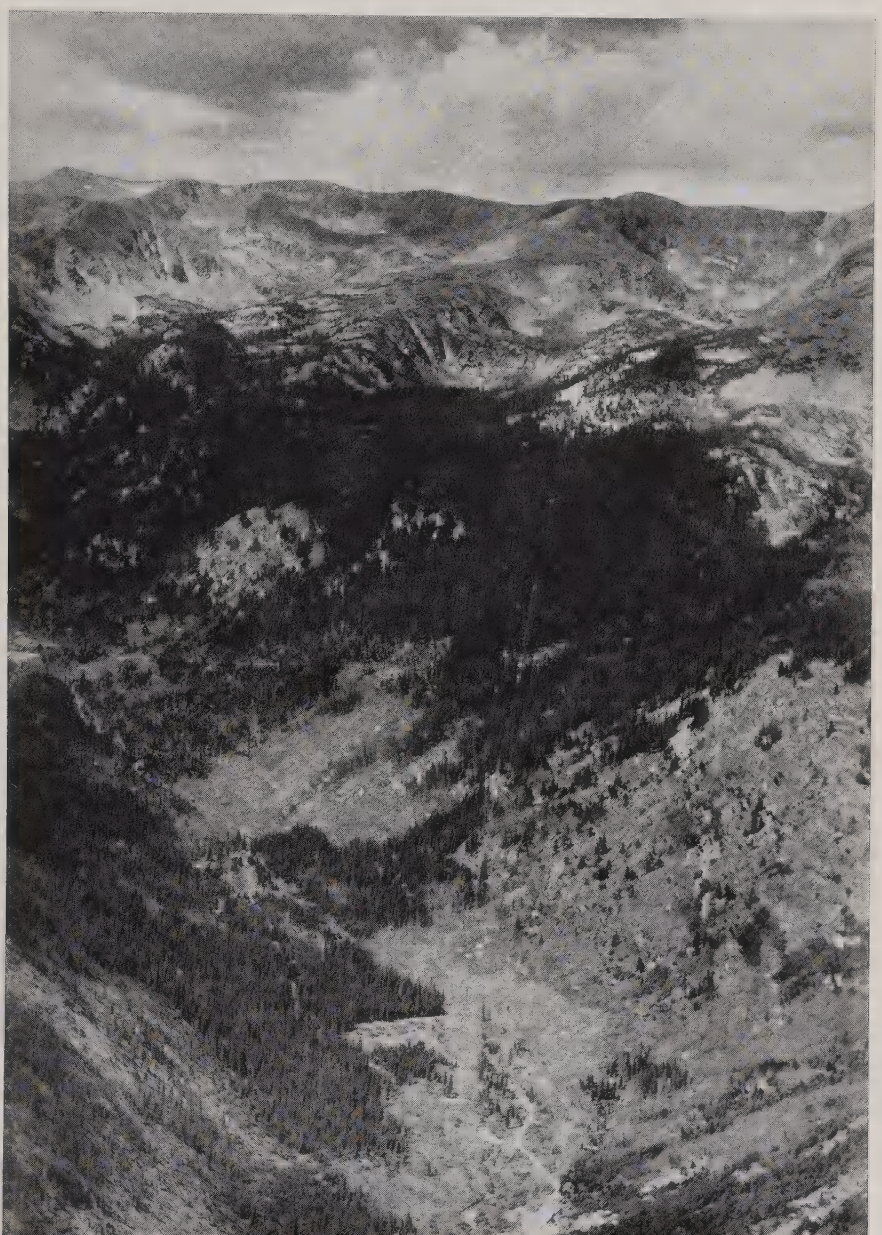


SCREENING PLANT AT EAST PORTAL THAT CONVERTED MUCK INTO AGGREGATES

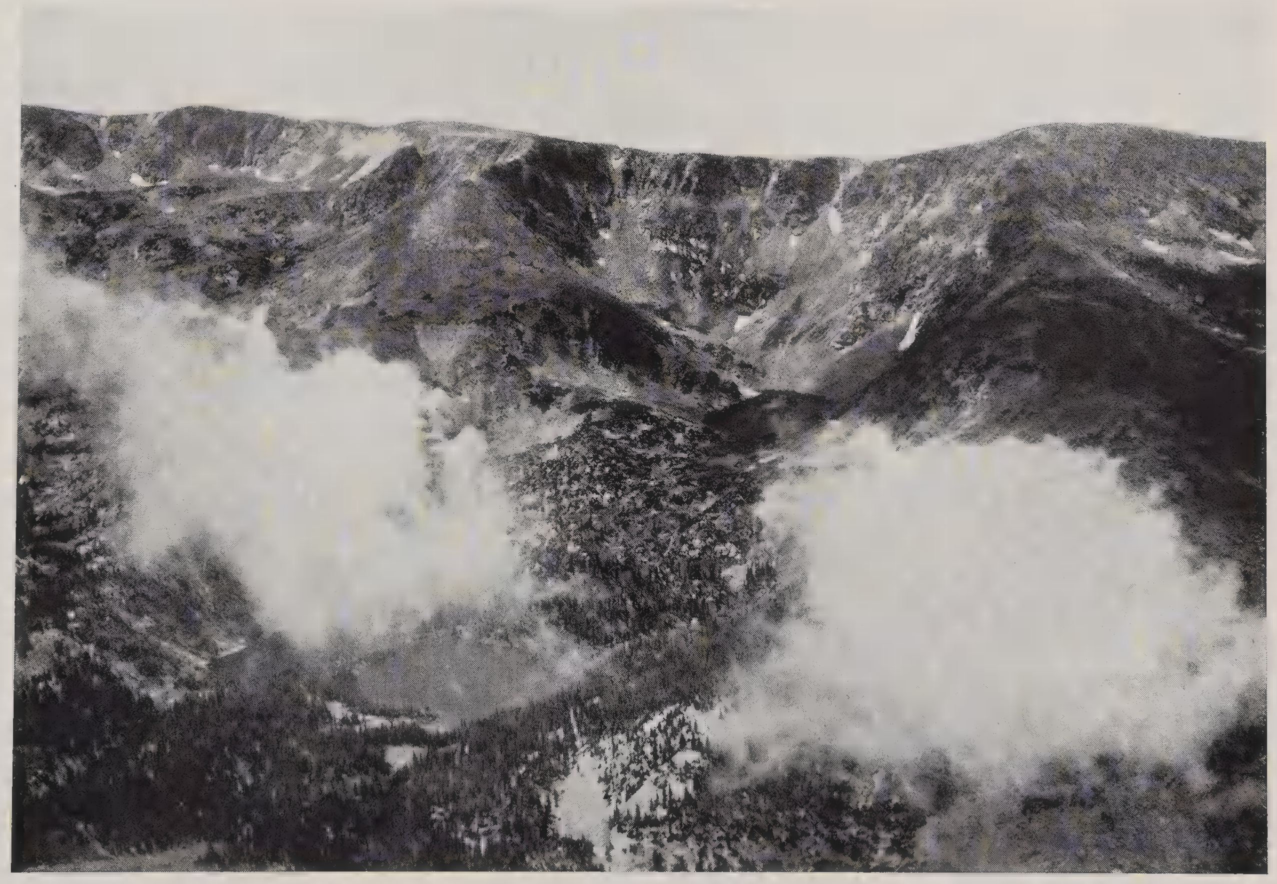
SNOW COMBS ON THE DIVIDE INCREASED HAZARDS OF RAILROAD OPERATION



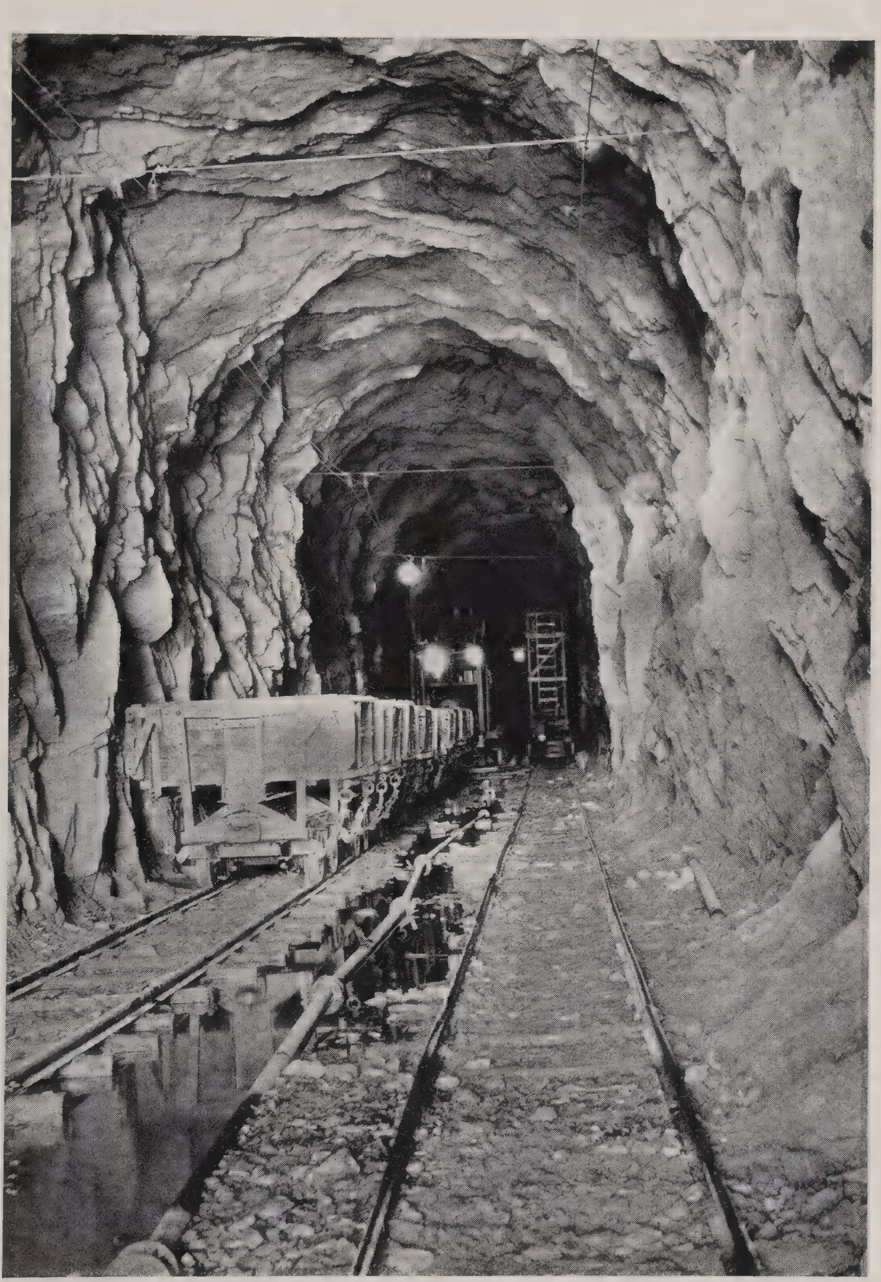
THE ROYAL GORGE ON THE ARKANSAS—ONE WAY TO PASS THRU A MOUNTAIN



THE OTHER WAY. POINT WHERE THE MOFFAT TUNNEL PENETRATED THE DIVIDE

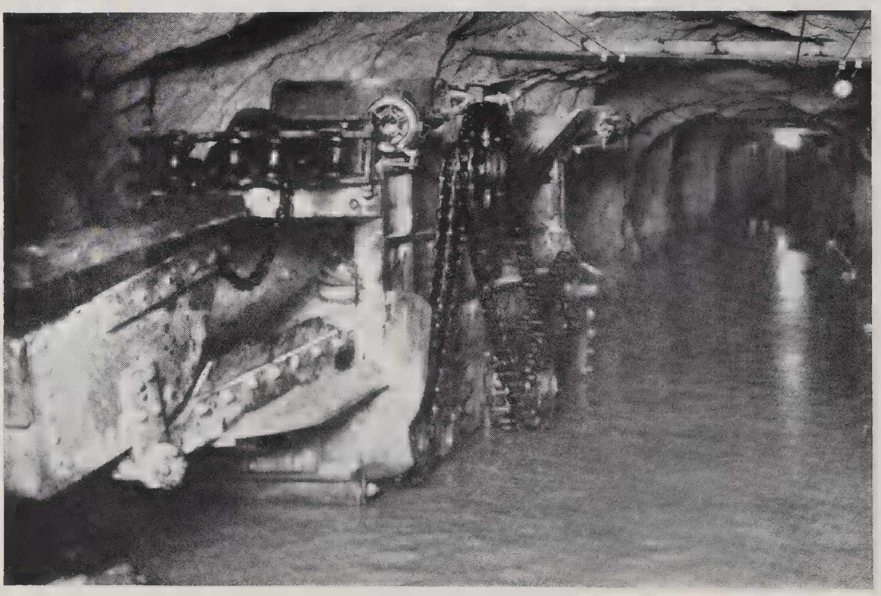


AIRPLANE PHOTO OF CRATER LAKES, ONE OF WHICH DRAINED THRU A FISSURE INTO THE MOFFAT TUNNEL *(Page 196)*

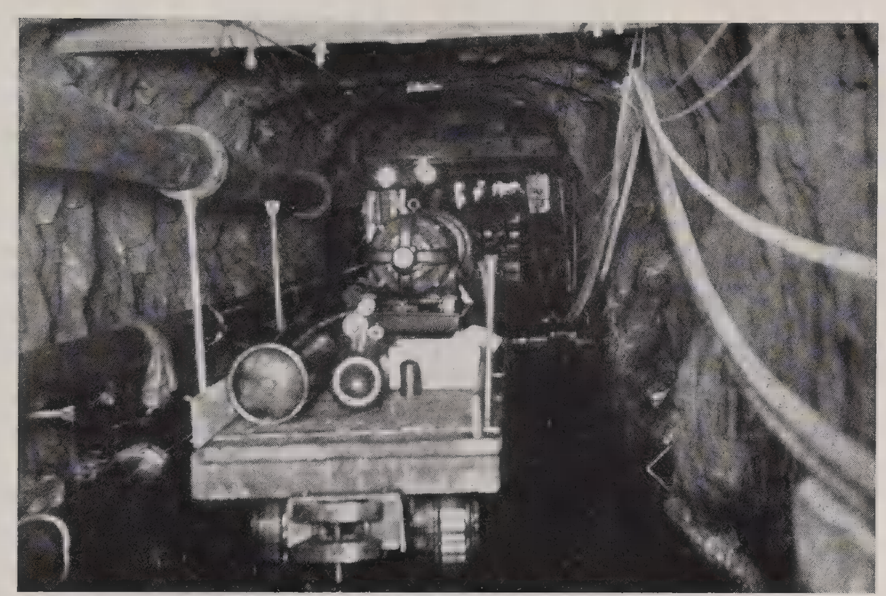


AN IDEAL COMPLETED RAILROAD TUNNEL IN SOLID ROCK AT EAST PORTAL

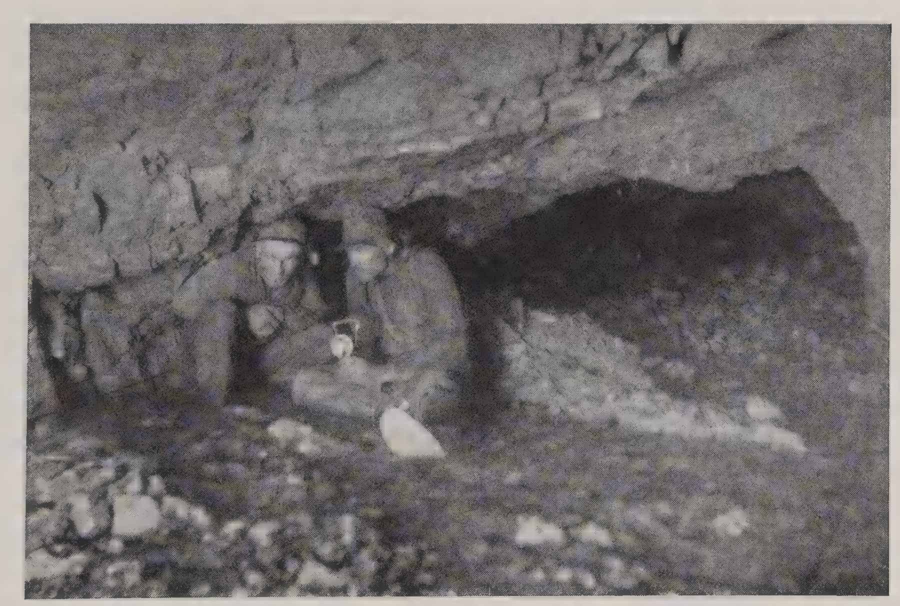
FOUR HUNDRED GALLONS PER MINUTE FROM WATER TUNNEL TO MAIN TUNNEL



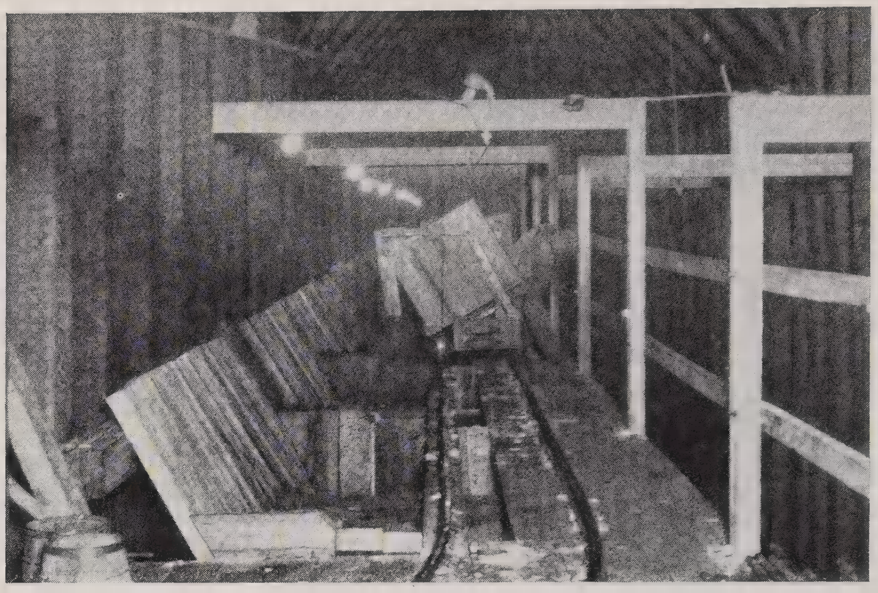
LOWER CRATER LAKE FLOWING THRU THE EAST PORTAL WATER TUNNEL



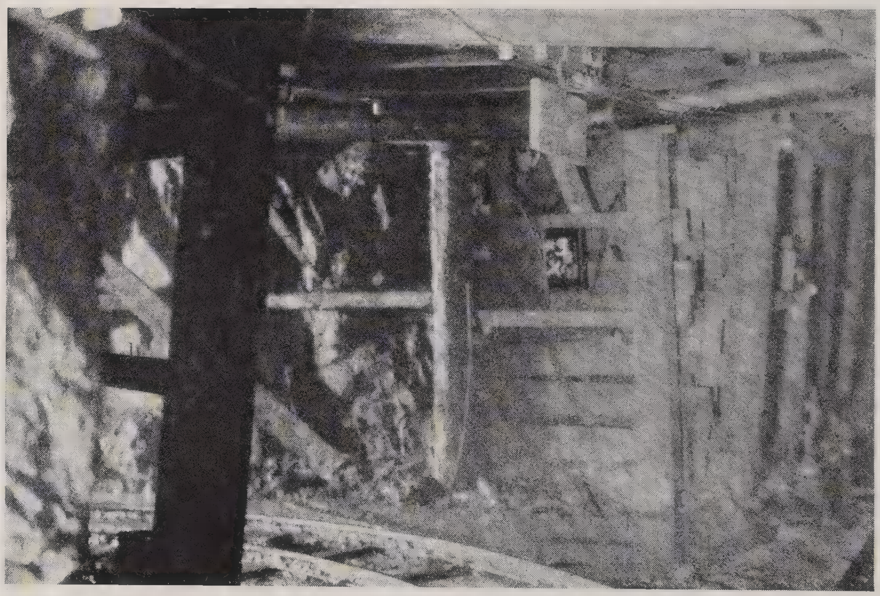
CENTRIFUGAL PUMP MOVED ON FLAT CAR IN THE 1926 FLOOD *(Page 233)*



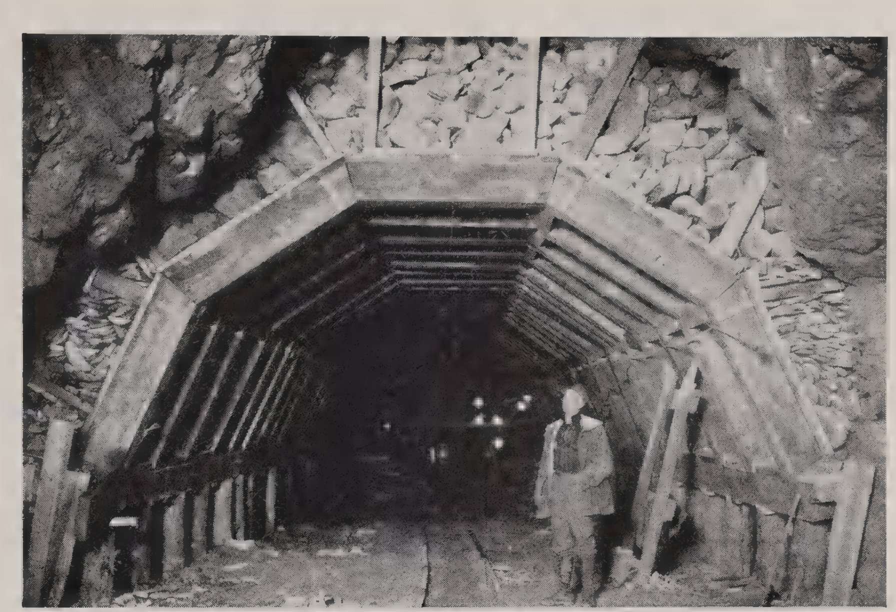
THE FLOOD FILLED THE TUNNEL WITH FINE-RUNNING SILT *(Page 234)*



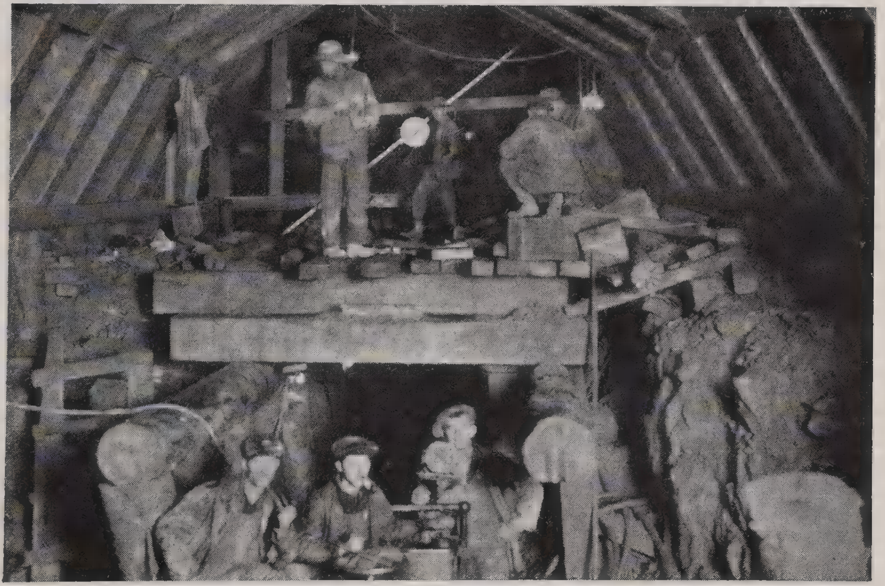
TRANSFER DOCK INSIDE WEST PORTAL RAILROAD TUNNEL *(Page 245)*



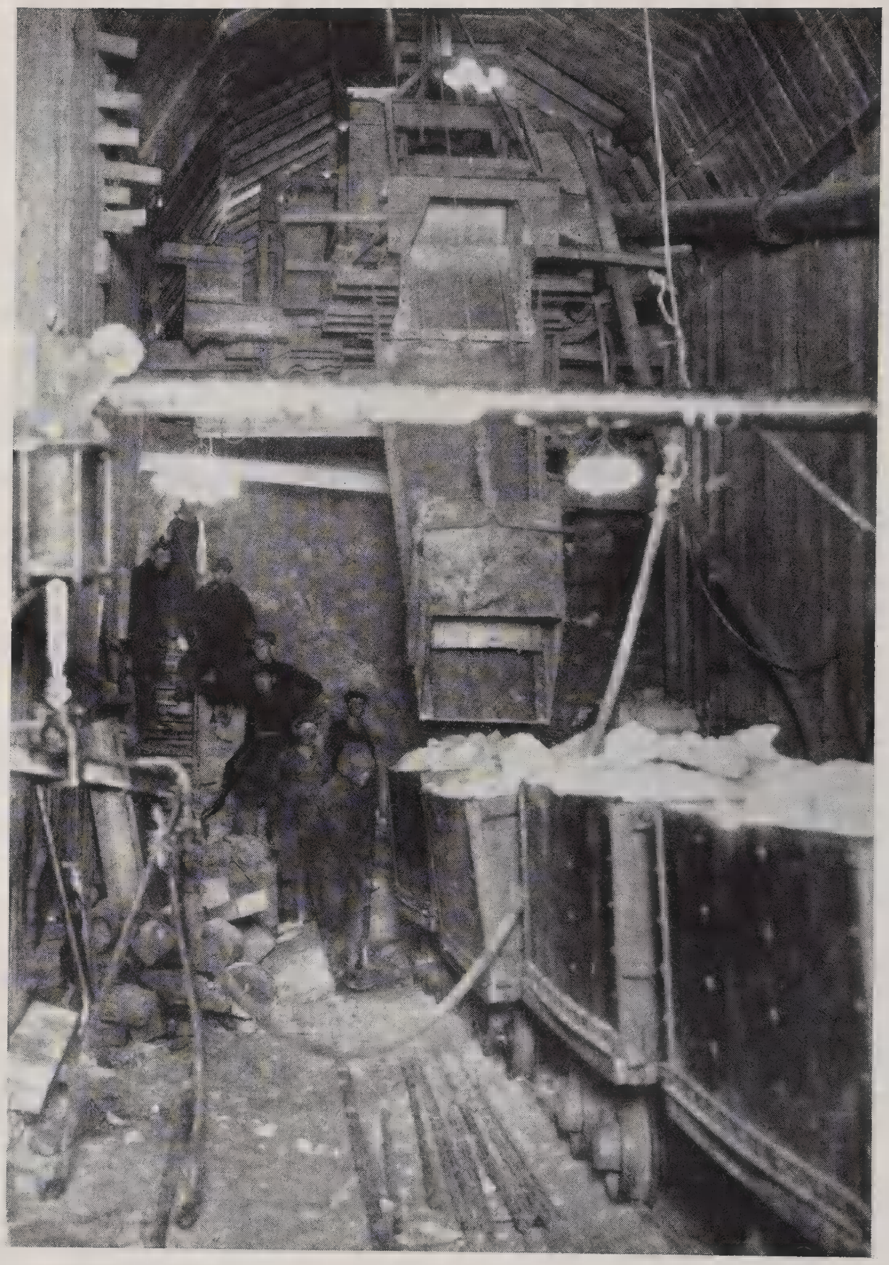
A WEST PORTAL CROSS-CUT SHOWING METHOD OF TIMBERING WATER TUNNEL



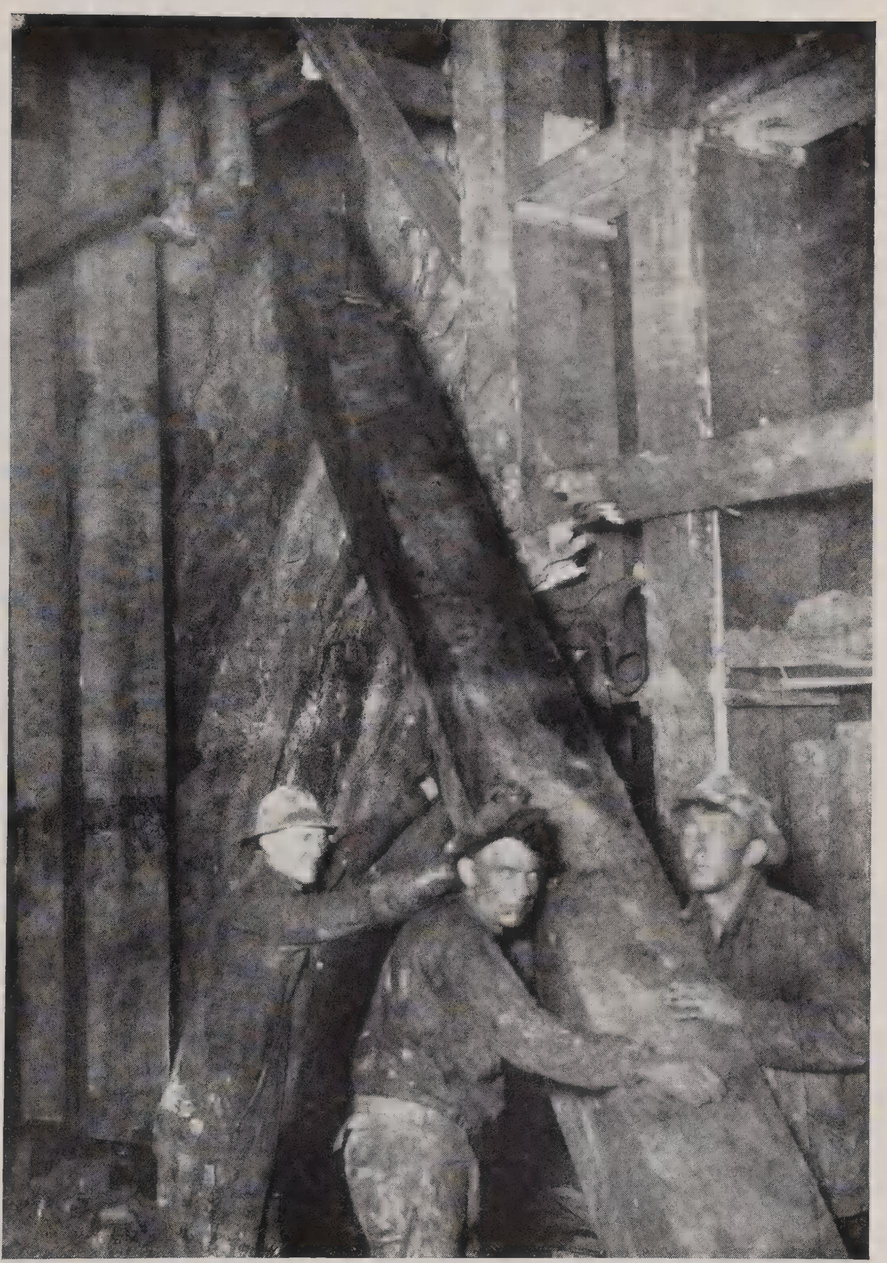
TOP-WIDENING OPERATIONS, SHOWING CORDWOOD FILLER IN THE OVERBREAK



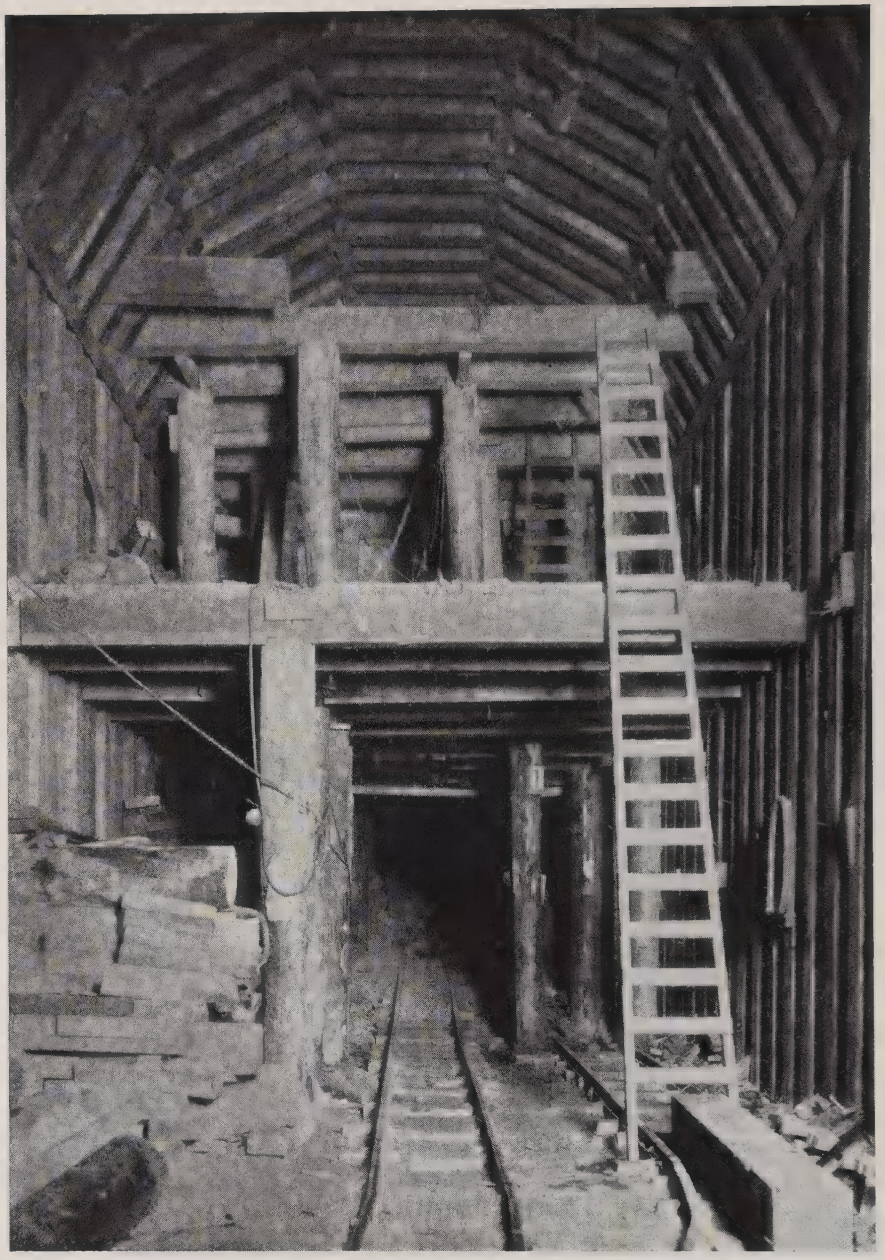
ENGINEERS MEASURING EXCAVATED AREA BY MEANS OF THE "SUNFLOWER"



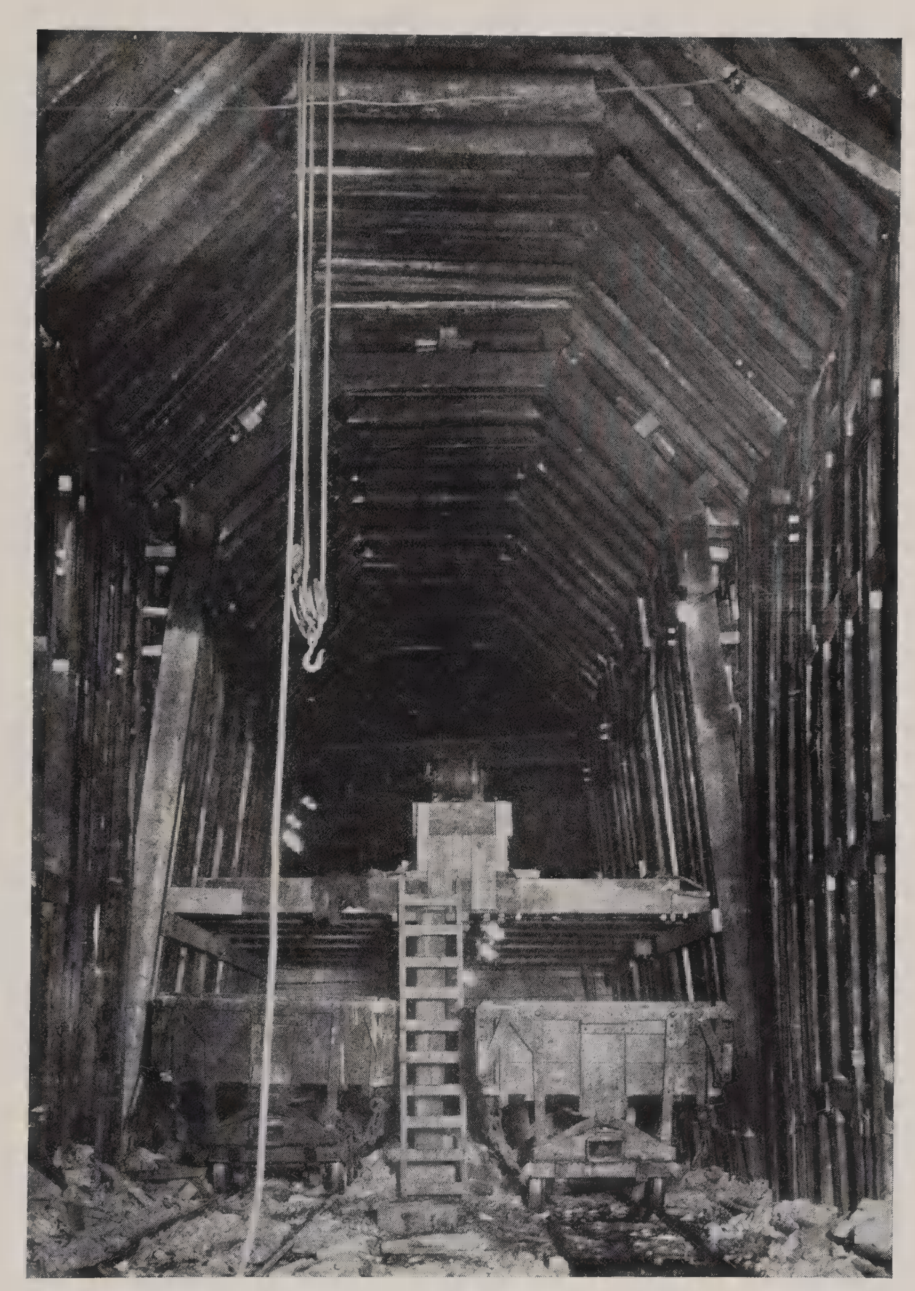
LEWIS BAR MUCKING THRU STEEL CHUTE AT CROSS-CUT NINE WEST *(Page 264)*



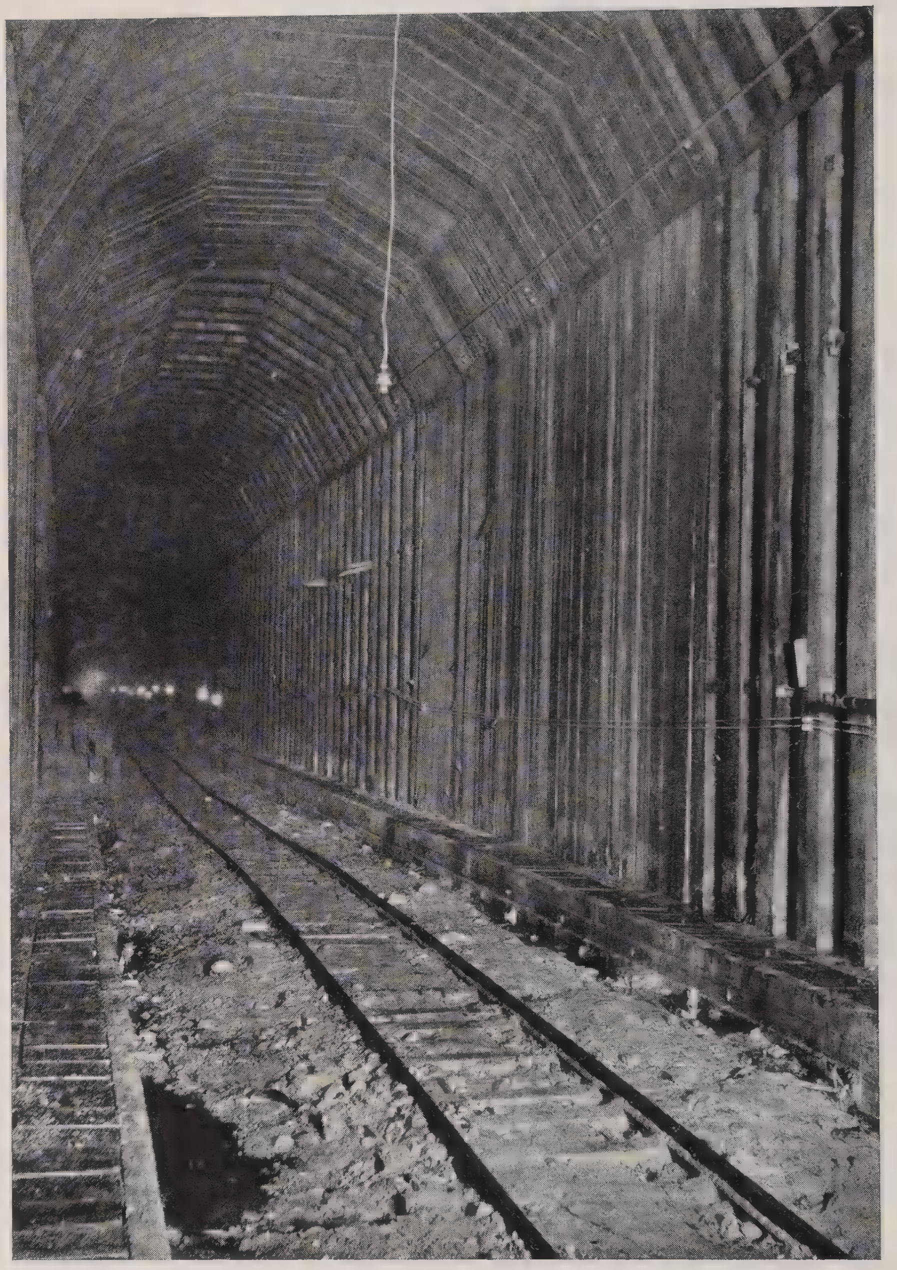
TIMBER CREW SETTING PLUMB POSTS AFTER BENCH EXCAVATION *(Page 240)*



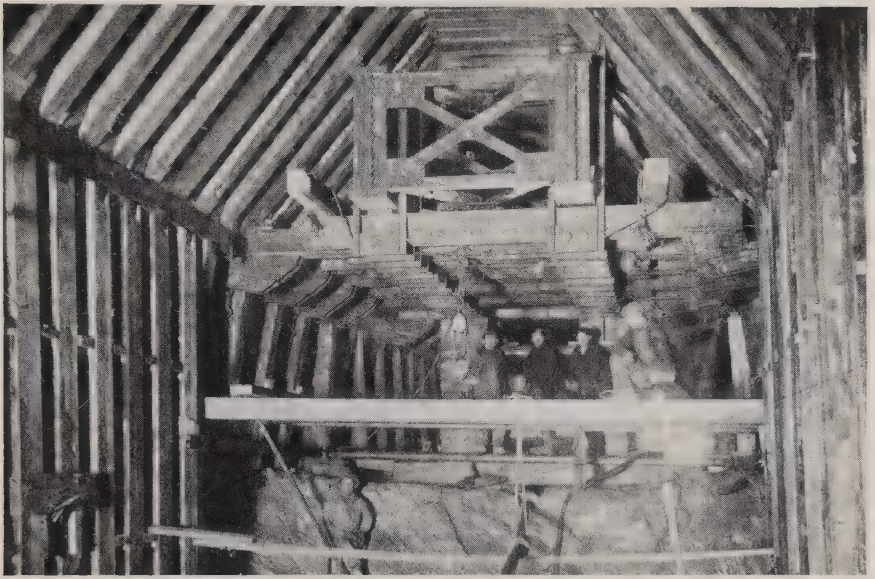
JUMBO SET AFTER TIMBERS HAVE BEEN PLACED NEAR CROSS-CUT NINE WEST



RAILROAD TUNNEL IN SOFT GROUND, TEMPORARILY BRACED FOR CONCRETE WORK



TIMBERED TUNNEL ON WEST SIDE: SKIN-TIGHT WITH DOUBLE RING *(Page 241)*



LEWIS TRAVELING CANTILEVER NEEDLE BAR IN SOFT GROUND *(Page 244)*

A SERIOUS CAVE-IN IN ONE OF THE WEST PORTAL CROSS-CUTS *(Page 241)*

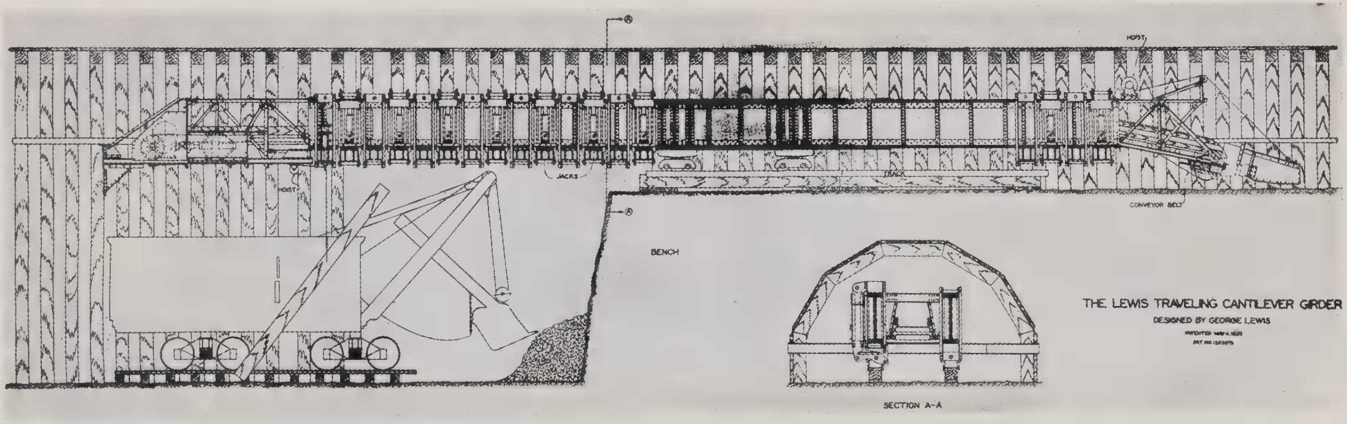
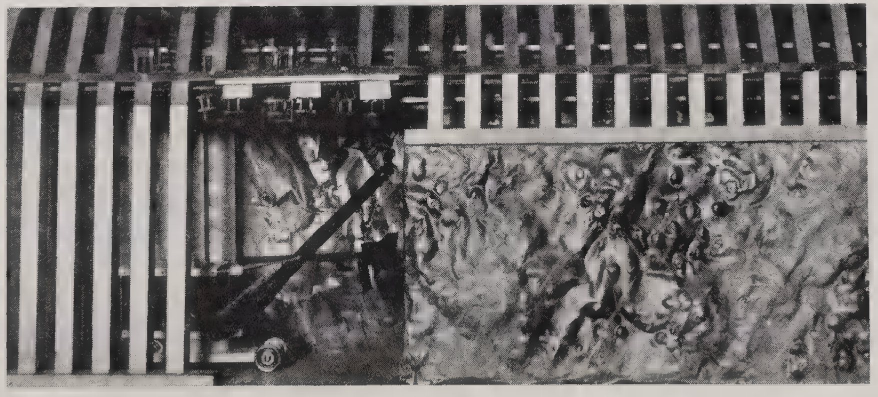


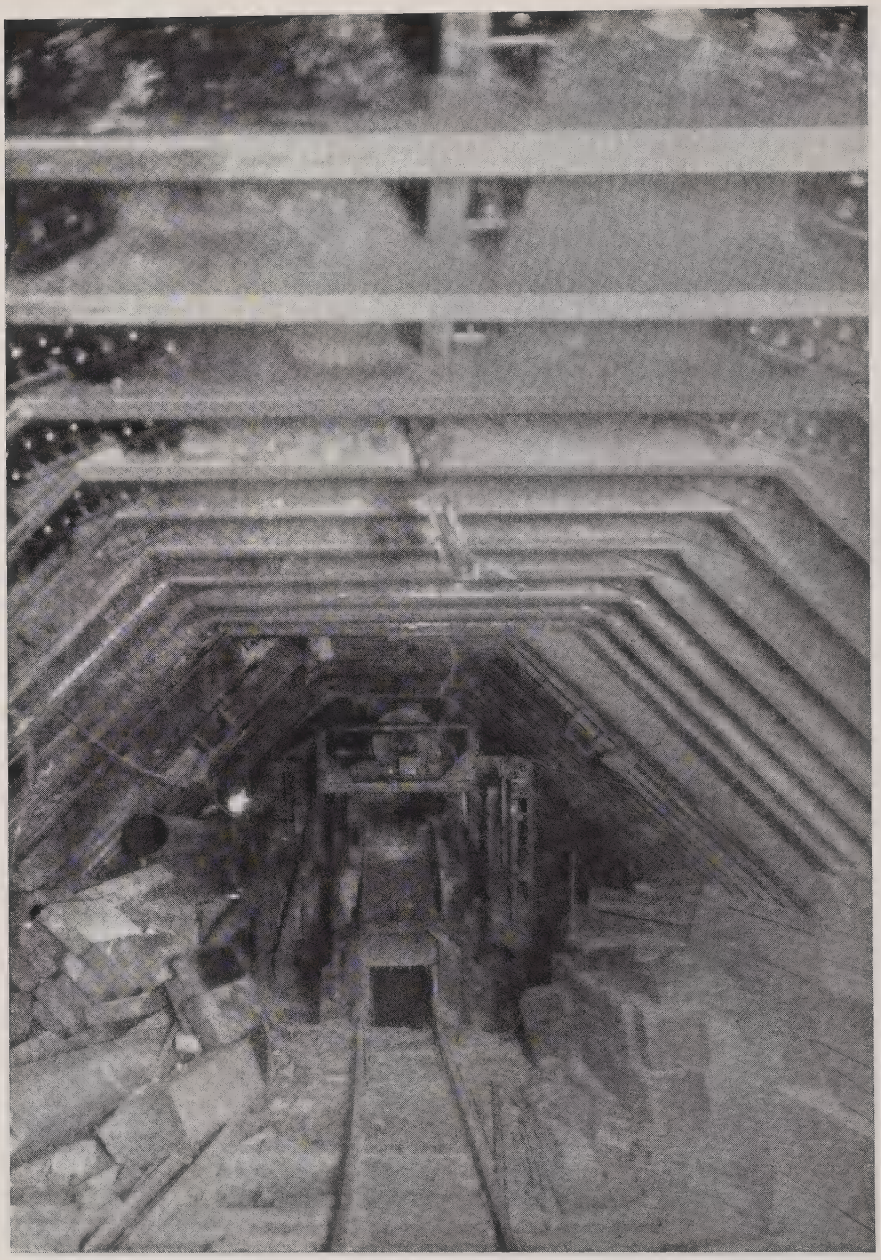
DIAGRAM OF THE LEWIS TRAVELING CANTILEVER NEEDLE BAR IN POSITION



TUNNEL MODEL, SHOWING AN AIR-SHOVEL OPERATING BENEATH LEWIS GIRDER

WEST PORTAL MINERS ON MUCK PILE AFTER WATER TUNNEL HOLING-THRU

GOVERNOR ADAMS (RIGHT) AND MAYOR NESLEN (LEFT) SHAKE HANDS *(Page 258)*



STEEL ARCHES AND INVERTS TO BE COVERED WITH HEAVY CONCRETE COATING

CHAPTER II.

CONSTRUCTION OF THE PORTAL CAMPS — CONSIDERATION GIVEN THE HUMAN EQUATION ATTRACTS HIGH TYPE OF LABOR — ALTERNATE SYSTEM OF WORKING HEADINGS DEVELOPED IN TWIN BORE — WORLD'S RECORDS BROKEN — METHODS OF TUNNELING — SOFT GROUND AT WEST PORTAL INCREASES COST — SECOND BOND ISSUE — INTERRUPTION OF OPERATIONS THREATENED — COMMISSIONERS RE-ELECTED — FIRST WATER FLOW ENCOUNTERED — CONTRACT SIGNED BY MOFFAT ROAD — THIRD BOND ISSUE — A DRAMATIC BATTLE WITH AN UNDERGROUND RIVER.

ONE of the distinguishing features in Moffat Tunnel construction has been the thoro and conscientious attention given the human equation by the Commission. In the days of the Pharaohs and the Cæsars, when tunneling was known upon an extensive scale, human life was the cheapest industrial commodity because slave labor could be requisitioned as needed thru the medium of war. Workmen frequently were sacrificed by the thousand to the ambitions of despotic rulers. Modern methods and machinery, as well as a more humanitarian viewpoint, have changed this situation completely. Instead of reducing the value of man-power, the invention of labor-saving machinery has taught the modern world the importance of conserving the human factor. The machine has enhanced man's economic worth.

From the inception of the work the Moffat Tunnel Commission bestowed as minute attention upon the comfort of the workmen as upon their safety. The high altitude at which the work was prosecuted and the prevalence of low temperatures and high winds in winter greatly increased the danger of pneumonia and other pulmonary ills as a result of lowered vitality induced by protracted colds.

Thruout the fall and early winter of 1923, the portal camps, at first mere collections of canvas tents, bustled with activity. Carpenters and mechanics were continuously at work erecting administration buildings, power plants, machine shops, tool-sharpening shops, mess halls, recreation halls. Bunk houses, each capable of housing thirty men—two men to a room—contained furnaces, electric lighting, hot and cold showers, laundries. Janitor service was included for each. Separate villages of neat cottages were constructed for employes with families. Billiard and pool tables, card tables, magazines and books, radio and moving picture machines were installed in the recreation halls, and pictures were shown several times a week. Commodious hospitals were equipped with every convenience of medical science, including X-Ray machines and operating rooms. Aside from deaths due to accidents in the tunnel, of which there were few in comparison to other great transportation bores,[229] nothing more serious than minor ailments and broken bones in hands and feet occurred.

Continuous service was maintained in the mess halls. Progress was uninterrupted either by day or night, except upon holidays, so there were three eight-hour shifts to be fed, in addition to call shifts when special work was required. Each shift took its own lunch into the tunnel, unlimited as to amount and variety, while hot coffee was sent to the men by electric locomotive at meal times. An average of three hundred men were employed at East Portal, while five hundred were at work on the west side.

The result of this thoughtful provision was manifested consistently by the type of employes secured. Free labor has learned to rebel against unhealthful working conditions or poor food, and the Commission found its attention to details amply repaid because it held the men on the job for longer periods of time than otherwise would have been the case. Floaters were far less common upon Moffat Tunnel construction than on ordinary work of this kind, where workers are compelled to wear oil-skins continuously as a protection against dripping water. The magnitude of the work and the glamour attaching to this first long transportation tunnel within the confines of the United States attracted many college graduates and students of engineering, who were glad to take positions as drillers and muckers to gain the experience. Average pay was five dollars and fifteen cents for eight hours' work. Contractors were distinctly alarmed when the restrictions upon immigration were placed in effect by the government, for they feared that it would be impossible to carry out great engineering developments, but at the wage quoted Hitchcock & Tinkler found that American labor could be secured and could do the work as well as the imported labor. Ninety per cent of the men employed on the Moffat Tunnel were American born, and a large percentage of these were from the State of Colorado. The labor, for the most part, was very intelligent and deeply interested in the problems of construction, and this fact enabled engineers and superintendents to train men on the job for such difficult employments as hard-rock drilling and blasting.

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[229] The total number of deaths in connection with Moffat Tunnel construction at the time we go to press was 19. We include only deaths due to accident.

From their own ranks, the men recruited camp orchestras, bands, quartettes and even dramatic clubs for the entertainment of the whole. Schools and Sunday schools were provided for the tunnel children.

Within the tunnel, every precaution was taken to protect life and health. Electric switch boxes were locked, and crews were not allowed to return to the breast of the heading after a round had been fired until the electric lights had been switched on again. The importance of these precautions was several times brought home forcibly to the men. Danger to life was not so acute in the earlier stages of construction when interest was high as it became after the work had settled into its routine course. A shift boss, who failed to wait for the lights to come on after a shot, was struck in the head by a falling rock and instantly killed. One of the most cautious and experienced electricians, after three years connection with the work, was electrocuted while repairing a pump, when he leaned against a high voltage wire carrying two thousand three hundred volts. He had not turned off the switch. An early precaution taken was the equipment with hot and cold showers of a changing room, where workers emerging from the tunnel could cool off gradually before exposure to icy blasts from the Divide. This very common danger in tunnel work was not so pronounced on the Moffat Tunnel construction as in some of the

Alpine tunnels where far higher rock temperatures were encountered.[230]

Especial care was taken to prevent the introduction of debilitating amusements. Wholesome entertainment was encouraged at all times, but the Commission frowned upon the public dance hall, the gambling den and the bootlegger. There never was a semblance of the frontier mining or railroad town at East or West Portal, nor even of the modern oil boom community. One bootlegger, arrested within the precincts of East Portal, received a lesson that warned away others of his ilk. The defendant employed a Denver attorney, who sought to evade the issue by application for a change of venue, based upon allegations of prejudice. The justice of the peace, Judge Orren Allen, also was chief inspector for the tunnel commission.

"You want a change of venue from this court?" he blandly inquired. "Very well, I will give it to you." He turned to the telephone and called the federal prohibition officer at Boulder and, while the attorney volubly protested, said: "I have a federal prisoner here for you. Send up and get him."

Simultaneous construction of the water tunnel and the main railroad heading permitted such co-ordination of effort in Moffat Tunnel construction that engineers were enabled to develop the alternate system of working headings with more pronounced success than ever attained before. The water tunnel was driven seventy-five feet, center to center, south of the railroad tunnel, and seven feet, six inches above its permanent grade. Dimensions of the water tunnel and the main tunnel heading were nine by eight feet, the railroad heading later being enlarged to sixteen by twenty-four feet to accommodate a single track railway. The breast of the water tunnel was kept constantly in advance of the railroad tunnel, not only to permit its use as a traffic way for removal of muck from both tunnels, and as a carrier for electric, water and air lines, but to explore the character of rock in advance of enlargement operations in the transportation bore. The engineers thus were enabled to prepare for rapid or cautious progress in widening the railroad tunnel heading to full size.

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[230] Average rock temperature in the Moffat Tunnel was 65 degrees Fahrenheit, increased 10 degrees when the mucking machine was in operation.

The alternating system of working one shift in two headings was designed to eliminate periods of inaction by the men. After drilling and shooting a round in the breast of the water tunnel the drill crew went directly to the main heading of the railroad tunnel. By the time a round had been drilled and blasted here the drillers could return to the water tunnel where the muckers had finished operations. Employing this system, workers in the Moffat Tunnel broke world's records for hard-rock tunneling by an advance of thirty-three feet in one heading of the water tunnel during one day's work, and an advance of fifteen hundred eighty-three feet in two headings in thirty days. This latter record was made between April 15 and May 15, 1925, at East Portal. The best previous records had been made in the Rogers Pass Tunnel on the Canadian Pacific. With the same number of men, working two headings but not using the alternate system, an advance of ten hundred thirty feet was made in thirty days. Moffat Tunnel records in one heading have been exceeded in construction of the Cascade Tunnel on the Great Northern. The single heading system was worked upon the west side of this bore only. With the same number of men in one heading engineers on the latter project reported an advance of eleven hundred fifty-seven feet in one month, as compared to the Moffat Tunnel record of seven hundred seventy-seven feet in one month. Conditions as to rock constituent in the Cascade Tunnel have been almost ideal thruout, and practically no soft ground has been encountered.[231] The Moffat Tunnel record for the

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[231] The following table, furnished by C. A. Betts, Office Engineer of the Moffat Tunnel, gives a partial comparison of records in several famous tunnels:

MOFFAT TUNNEL:	
Best month's work in one heading	777 feet, 3 shifts, 1 crew each
Best 30 days' work in two headings	1,583 feet, 3 shifts, 1 crew each
Best 15 days' work in two headings	812 feet, 3 shifts, 1 crew each
Best day's work in one heading	33 feet, 3 shifts, 1 crew each
Best month's work, bench enlargement	1,002 feet, 2 shifts, 1 crew each
Best day's work, bench enlargement	53 feet, 2 shifts, 1 crew each
ROGERS PASS:	
Best 30 days' work, 2 headings (not alternating)	1,030 feet, same number of men
Best 30 days' work, twice the number of men	1,580 feet,
CASCADE TUNNEL:	
Best 30 days' work in one heading	1,157 feet, same number of men
SIMPLON TUNNEL:	
Best 30 days' work	685 feet, same number of men

best progress in two headings in thirty consecutive days, however, still stands as a world's record, an accomplishment all the more remarkable because of the unparalleled extent of soft ground.

The alternating system has been found impracticable in soft ground, so that it was employed on the east side of the Moffat Tunnel only, while driving thru solid rock. During the two years that the system was employed a monthly average of twelve hundred feet advance in two headings was maintained by one drilling and one mucking crew.

Twin tunnels were first employed in construction of the Simplon Tunnel, and both tunnels later were enlarged to full size to carry single track railroads. The method was adopted in construction of the Rogers Pass Tunnel, with the modification that one tunnel was driven heading size and called the "pioneer bore." Only in the case of the Moffat Tunnel has this small tunnel been driven with the idea of future use after completion of the major bore. It remained also for the Moffat Tunnel engineers to develop greater use for the small tunnel during the construction period. Main tunnel enlargement operations were carried on simultaneously, east and west, from several cross-cuts at one time, thus multiplying the load carried by the water tunnel.

Pure air, of course, is a vital necessity not only in tunneling, but after the tunnel is completed. Blower fan installations, one of which operated at each portal, were installed in niches cut into the side of the water tunnel between the breast of that tunnel and the last cross-cut. On the portal side of this cross-cut bulkhead doors were placed, while all cross-cuts beyond this point also were bulkheaded. Low pressure air was delivered to the men in the railroad heading thru the last cross-cut—left unobstructed. Immediately after a round had been fired high pressure air, released from the pipes feeding to the air-drills, helped dissipate the poisonous powder fumes and enabled crews to resume work within twenty to thirty minutes after the explosion. The water tunnel served as the intake, the railroad as the exhaust for air.[232]

Electric locomotives, mucking machines, blowers and electric centrifugal pumps were driven by a power line carrying two thousand three hundred volts, regulated by motor generators and transformers to suit the special need.[233] Two types of electric locomotives were used, one operated by trolley and utilized for heavy duty; the other run by storage battery and used in the advanced headings.[234] In the railroad tunnel, where sufficient headway was obtainable, Osgood Air Shovels were employed in enlargement operations, while in the headings, Conway electric-driven mucking machines were necessary because of their compact proportions. The average time for mucking a round, utilizing nineteen cars with combined capacity of seven hundred fifty cubic feet, was two hours and seventeen minutes.[235]

A cycle of operations began in the headings when the man-train delivered a shift of fourteen men at the breast of the tunnel.[236] A special drill-carriage mounted upon a truck and equipped with a swivel to permit operators to raise or depress the bar carrying the drills, was wheeled into position and adjusted. This carriage, perfected for Moffat Tunnel work, was a great improvement upon all previous machines of the kind, and effected an appreciable saving in time.[237] The drillers took position, with drills pointed at the desired angle, the air pressure was released and each drill, like some monstrous subterranean woodpecker, beat out its tireless and deafening tattoo—the dramatic song of steel to stone that has revolutionized life upon

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232. Two Root blowers at each end of the tunnel delivered 4,320 cubic feet of air per minute against 4 pounds pressure. In addition two fans, discharging 12,000 cubic feet of air per minute at one-half ounce, fed the air to the headings. There was no mechanical exhaust. This system was suggested by D. W. Brunton. Four compressors at the west end of the tunnel furnished 4,300 cubic feet of free air per minute. Five compressors at East Portal furnished 4,000 cubic feet per minute at East Portal. When air drills and clearing pressure both were used the total output of the compressors was used. Compressed air was utilized for heading pumps, hoists, guniting and the Osgood air shovel, which took the output of one compressor when in use.

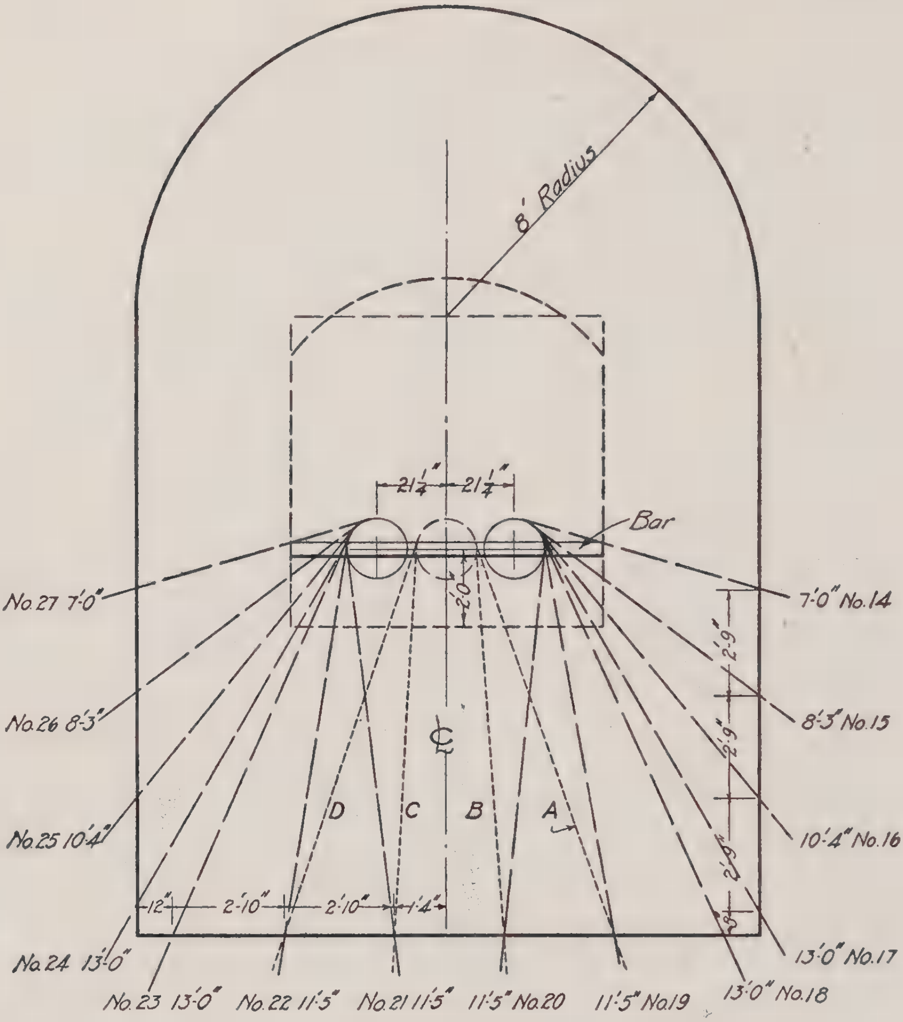
233. The electric power line, direct to each portal, delivered three-phase energy at a frequency approximately 61½ cycles and a potential of 44,000 volts. Outdoor transformer stations at the portal camps converted this energy into an alternating current of 2,300 volts, and motor generators, within the tunnel, rectified delivery to a point where 250 volts or 444 volts direct current was supplied for running machinery. For the lighting system a further reduction to 110 volts was made.

234. Eight-ton and four-ton locomotives were employed, each equipped with a cable reel that gave it a cruising radius of five hundred feet.

235. *The Contractors' Story of the Moffat Tunnel.* F. C. Hitchcock.

236. A drill crew consisted of 4 drillers, 2 helpers, 1 nipper. The mucking crew held 1 operator, 1 scaler (to scale down loose rock), 3 laborers, 1 motorman, 1 brakeman. A foreman had charge of both crews. Under the alternate heading system 17 men constituted a shift.

237. F. C. Hitchcock is authority for the statement that one round each shift of eight hours was ideal progress. Ingersoll-Rand 72s were used for drifting; Denver Rock Drill 17 for stoping. Drill carriages could be set up in from 10 to 20 minutes as against 40 minutes to one hour to set columns or bars and drills. Model drilling time for a round in hard rock is given by Hitchcock as 2 hours, 39 minutes. Hitchcock, *op. cit.*

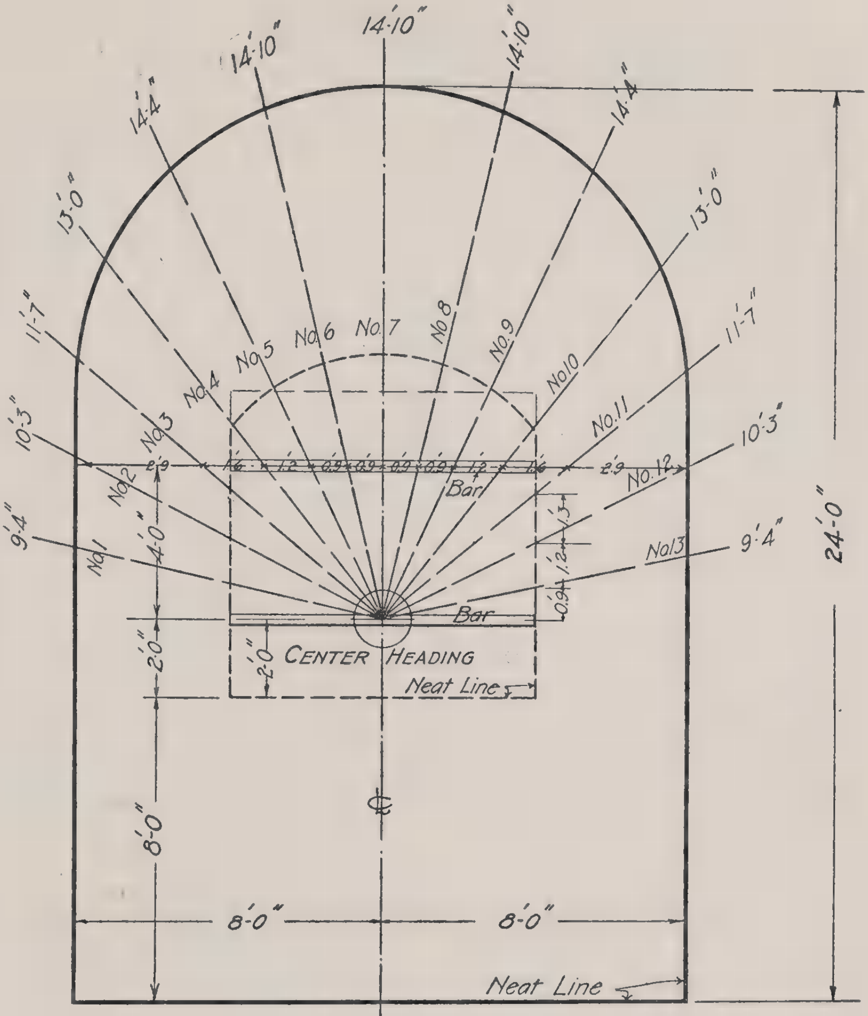


DRIFTER SET UP FOR DRILLING BOTTOM HOLES

When steel cannot be changed in side positions, drill holes A·B·C&D = 19, 20, 21 & 22 from center of bar.

RING DRILLING DIAGRAMS – R.R.TUNNEL

RING-DRILLING DIAGRAM. DRIFTER SET UP FOR DRILLING BOTTOM HOLES

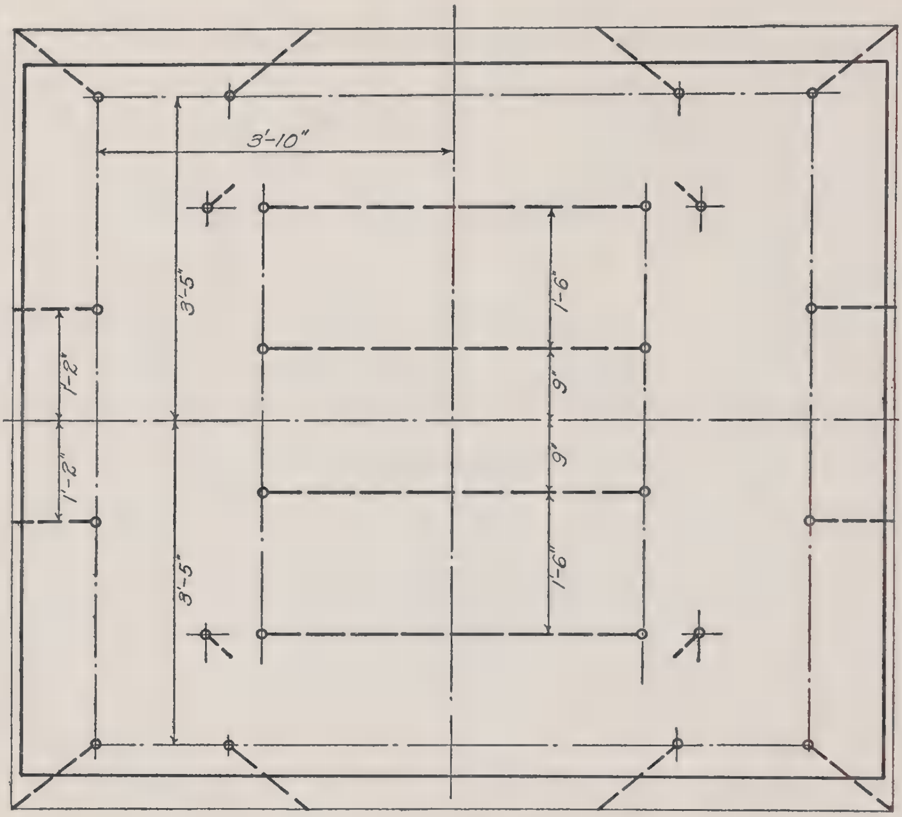


POSITION OF STOPER FOR DRILLING TOP HOLES

MOFFAT TUNNEL COMMISSION
MOFFAT TUNNEL
THROUGH THE CONTINENTAL DIVIDE
GRAND AND GILPIN COUNTIES
COLORADO

Title Stoper and Drifter Drill Set-Ups for Enlargement Ring Drilling.
Scale 1" = 2'.
Date 3/28/25.
Chief Engineer R.H. Keays.
Drawn by G.G.
Traced by C.B.
Checked by
Designing Eng. C.A.Betts
Drawing No.
Sheet No.
Accession No. 160
File No. 6-T-49

RING-DRILLING DIAGRAM. POSITION OF STOPER FOR DRILLING TOP HOLES



MOFFAT TUNNEL COMMISSION

MOFFAT TUNNEL

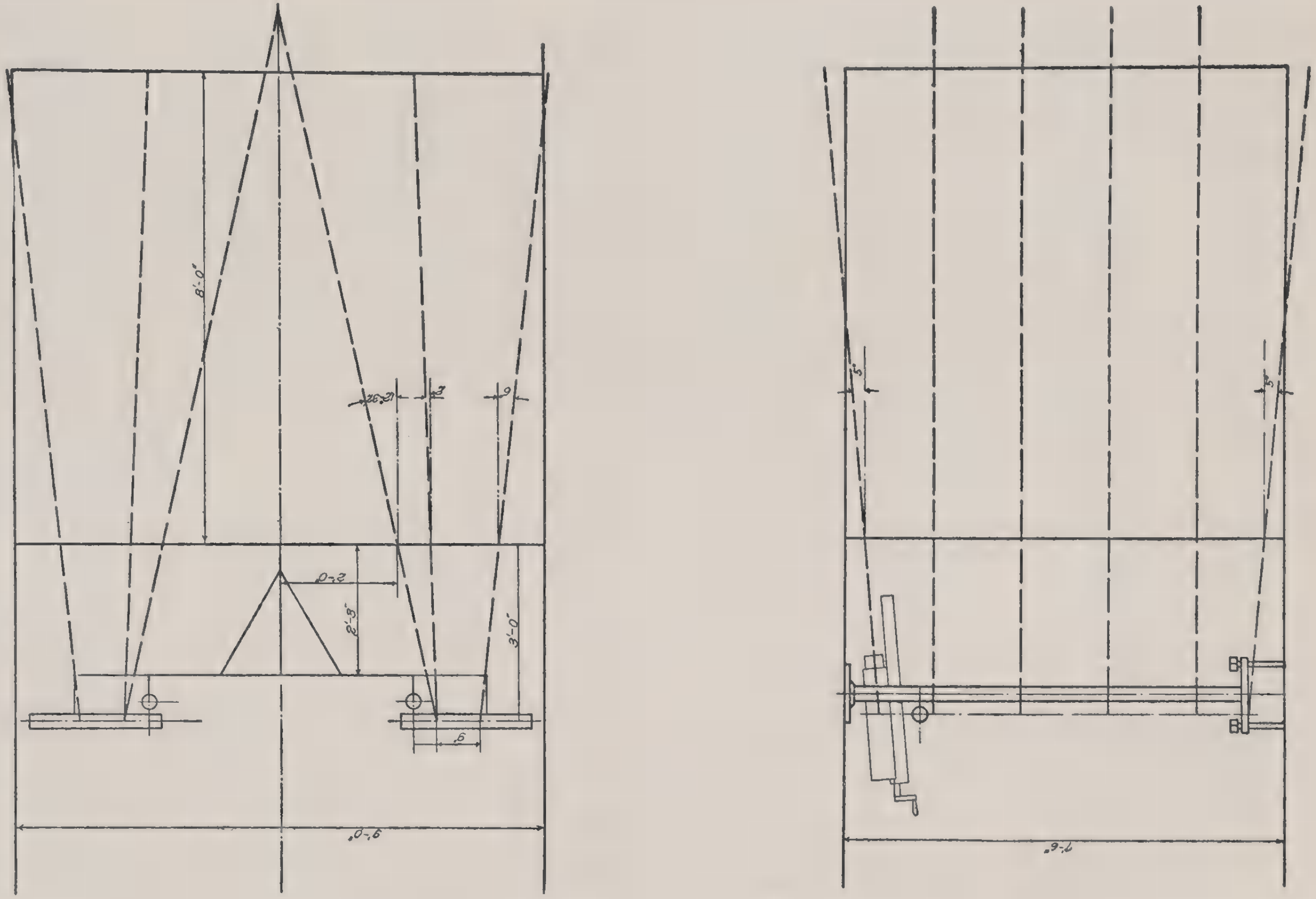
THROUGH THE CONTINENTAL DIVIDE

GRAND AND GILPIN COUNTIES
COLORADO
East Portal

Title Standard Eight Foot Round to be Drilled with Fixtures and Template
Scale 1inch = 1Foot
Date 3-26-24
Chief Engineer
Drawn by G.H.
Traced by G.H.
Checked by
Designing Eng. B.G.Coy

Drawing No.
Sheet No.
Accession No. 100
File No. 6-T-14

STANDARD EIGHT-FOOT ROUND TO BE DRILLED WITH FIXTURES AND TEMPLATE



CROSS-SECTION OF STANDARD ROUND. THE CENTRAL CONE IS FIRED FIRST this planet. These carriages were used only in what is known as heading-drilling, which was employed in the enlargement operations. Twenty-four to twenty-six holes, from four and one-half to ten feet deep, spaced to equalize the burden, were drilled. The eight central holes converged toward a common point and marked a cone-shaped wedge of rock, blasted first by direct firing. Electric delay exploders successively fired the remaining holes, each shock coming inward upon the already broken area. A drill round is eight feet in depth, and in hard rock, under favorable conditions, an average of three rounds could be drilled in twenty-four hours. However, the method of drilling and firing varied with the nature of the ground. In soft rock, fourteen to sixteen holes constituted a round. In headings in soft ground the straight-ahead method of drilling was employed, two drills being mounted upon a horizontal bar, attached to the sides of the tunnel. In soft ground, using this method, drillers were able to resume drilling from the top of the muck-pile after it had been lowered half way by the muckers. In ring-drilling for enlargement around this center heading twenty-seven holes from seven to fifteen feet in depth were drilled in rings four feet apart for side enlargement of the railroad tunnel. The average charge of dynamite was forty to sixty per cent on the east side and thirty-five to forty per cent on the west side, altho no gelatine was needed in the worst ground. Altogether, two million, seven hundred thousand pounds of explosives were needed to blast the big hole thru the mountain, while some fifty thousand pieces of steel were sharpened.

To the miners, the firing of a round becomes a purely perfunctory matter, but to one unfamiliar with underground excavation, this event is the most dramatic moment in the cycle. Sheltered by the protecting wall of the cross-cut, to which all miners and machinery have been withdrawn, the curious visitor waits, nerves tensed in expectation. Perhaps he may wonder at the unconcern of the miners, idly chatting or bantering one another. Presently there comes a dull, low boom.

"Is that the blast?" is the inevitable question of the novice, voiced in a tone of disappointment. Before a reply can come the questioner needs no answer. A pulse-like quiver follows the first report; a curious, low, beating sound that seems to shake the walls and the ground beneath the feet as tho a seismic disturbance had occurred. The fluttering vibration enters the human body, throbs thru the veins, the very bones, so all-pervasive and penetrating that one wonders whether one's own heart is not seeking to burst its startled course thru the breast. The thought occurs involuntarily that if this terrible pulsation does not cease the solid rock itself must give way and crush the human atoms beneath its incalculable weight. Another explosion follows—another—another—irregular in time, seemingly interminable in duration. After each shot comes that insistent beating upon the brain, that awesome synchronization of human pulse and earth pulse. It is as tho the Mountain had taken sentience and, with its timeless heart, was ticking off the centuries, age upon age, eon upon eon.

Presently a pall of smoke faintly tinged with greenish hue drifts up the tunnel; a pungent, acrid odor assails the nostrils, strangling in its intensity. The walls grow dim, the figures of the miners assume grotesque proportions like gnomes. As the watcher strains his eyes, seeking to dispel the unreality, he notes a swirling motion in the smoke. Under the current of high pressure air, roaring at the breast of the tunnel, the opaque wall thins and grays, the air becomes clearer and sweeter as the poisonous powder fumes are driven outward toward the portal. Within fifteen or twenty minutes a stubby electric locomotive backs into the cross-cut, switches are thrown, the trolley wire emits a succession of blue sparks, steel wheels roar upon the tiny two-foot gage track. The tunnel bustles into activity again. A driller's helper comes to the cross-cut siding, examines a pile of newly-sharpened drills thrown from the locomotive, selects several and trudges down the cross-cut toward the railroad tunnel where the drill crew is at work. The rugged, compact Conway mucker rolls into the water tunnel and is propelled toward the muck pile dislodged by the last explosion. Gently it noses into the oozing pile of loose rock; then, with a rooting movement curiously suggestive of a giant hog, it shoves a powerful scoop into the pile. Machinery rattles, the shovel sweeps upward and rearward, dumping its load upon an endless belt conveyor which, in turn, conveys the muck to the rear of the machine and dumps it into a fifty-foot Koppel car, spotted beneath the belt. Back and forth, back and forth, the mechanical hog roots its way into the muck pile, which steadily diminishes before the onslaught. Two minutes pass—the car is filled. A laborer adjusts two huge steel claws, one under the forward end, one under the rear of an empty. There is a roar of compressed air, the air hoist lifts the car to one side and swings it back into position on the loading track, while the loaded car is being hauled rearward to the muck train. In turn, this is filled and removed. Thus the work proceeds until, at the end of an hour, a string of eighteen to twenty cars is resting on the siding. Far down the tunnel comes a faint rumble and, looking in that direction, the spectator sees a light that sways and bobs crazily, distinguished from the long line of stationary lights by its motion. This light grows larger and larger, its motion more and more erratic, the roar swells in volume until it overpowers every other sound. With a grinding of wheel upon rail, the locomotive slows to a stop at the end of the waiting train of loaded cars. A coupling pin rattles and a lantern waves its lateral signal. The visitor hops upon the squat locomotive as the muck train gets under way, and from his swaying, jolting perch watches the gloomy, dripping walls and roof flow by; now he catches a glimpse of the great centrifugal pump thumping away in the sump where water is delivered from the headings by lighter air pumps. Black cross-cuts yawn —and disappear. A glare of light comes from the drill-doctor's station, as tho someone had suddenly opened and closed a door. All thru this Dantesque ride the ludicrous locomotive bucks like a western broncho. At last, a tiny square of gray light appears far ahead; the tunnel grows lighter; the temperature seems to drop twenty degrees in as many feet. Soon the train passes thru the snow shed at the portal entrance, and runs out upon the dumping dock. The side-dumping cars are emptied into the four-yard cars on the track below, and the second train, drawn by a powerful electric locomotive, moves out upon the wide, level dump, which is to be the tunnel approach for the railroad. Day after day, the core of the tunnel has thus been hauled from the underworld to the light of the sun. Seven hundred and fifty thousand cubic yards of rock represent the four years' toil of those human ants who excavated the Moffat Tunnel.

While in the hard rock at East Portal timbers were not needed to prevent caving, but in certain localities the rock showed a tendency to disintegrate and spall upon exposure to the air. To prevent this occurrence, gunite—one part cement to three parts sand—was applied to roof and walls. Gunite could be used only where there was no pressure to be resisted, and where the rock was not too badly shattered by blasting. A coat of gunite one and one-half inches in thickness, applied immediately after excavation prevented weathering and consequent sloughing. The cost was one-tenth that of timbering and a smooth surface was provided to reduce the friction in the flow of ventilating air. Sand for guniting, as well as for concrete aggregates and ballast, was manufactured from excavated rock at the East Portal crushing plant at the rate of one hundred fifty cubic yards a day.[238]

Soft ground was encountered from the first at West Portal and altho it had become apparent late in 1924 that the estimated cost of the work would be exceeded, due to this factor, the Commission was hopeful until the last year of operations that several months could be saved in the estimated length of the construction period.

In his first report, dated July 16, 1924, President Robinson of the Commission pointed out that the cost of headings up to that time had been far below the contractors' upset price, while enlargement operations in the railroad tunnel had run only a few cents above the estimated cost.[239] When the excellent rate of progress is taken into consideration the President was fully justified in his assumption at that writing that the tunnel would be completed within the estimated cost and time limit, altho he admitted that the amount of timber placed in the railroad and water tunnels on the west side had added fifty thousand dollars to the estimated cost of timbering alone. Six months later he reported that instead of fifteen hundred feet of soft ground the tunnel had passed thru six thousand feet.[240]

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[238] An outlay including a gunite machine, cement and sand platforms and trackage, costing less than $2,000, made it possible to cover 500 square feet of tunnel wall in an eight-hour shift with two coats of gunite, aggregating 1½ inches in thickness, at a cost of 14 cents per square foot. Thickness of the gunite coats have varied according to the type of rock encountered from one-half inch to five inches. *Engineering News-Record*, Vol. 96, No. 7, 285.

[239] Cost of headings up to that time had been $10.36 per cubic yard as compared to the contractors' upset price of $17.00; while enlargement costs had averaged $4.85 per cubic yard as compared to the estimate of $4.70 per cubic yard. Statement of Cash Receipts and Disbursements, Moffat Tunnel Commission, May 12, 1922, to July 7, 1924.

During the winter of 1924-1925 the conclusion was forced that approximately one-half mile of completed railroad tunnel on the west side would have to be reinforced, due to unforseen settlement and crowding of wall plates. This, in turn, necessitated lowering the grade for that distance nine inches, and greatly delayed progress.[241] Supplemental bonds in the amount of two million five hundred thousand dollars, bearing interest at five and one-quarter per cent were issued January 1, 1925, and sold at par and accrued interest to R. M. Grant & Company, March 20 and 21.[242]

The necessity of a second bond issue precipitated the most acute crisis in the history of Moffat Tunnel construction. This was due to the fact that the Commission was uncertain as to the extent of its powers under the Moffat Tunnel Act. The question uppermost in the minds of all was whether bonds in excess of six million, seventy hundred twenty thousand dollars could be legally issued against the District.

The tunnel was then about one-third completed; one million dollars was invested in equipment; interest charges on the bonds already out amounted to one thousand dollars a day. Cessation of work for any considerable length of time meant a tremendous loss and expense. The Commission was faced with the responsibility of keeping its contractural agreements, and with the mandatory provision of the Tunnel Act to build the tunnel.

An ugly political situation also existed. Under provisions of the Act the Commission would be compelled to run for re-election in July, 1925. Either the Commission must go to the legislature, then in session, and ask for enlarged powers of taxation, or find sufficient power for that purpose in the Act as passed. The General Assembly of 1925 was known as a Klan legislature, for the Ku Klux Klan was in control of that body. To have asked for enlarged powers would have brought the Commission likewise under Klan control. There was also the ever-present danger that should the crisis become known publicly opposition railroads would step in as they had so often done before and block the program either in the legislature or in Eastern financial markets. In short, the Moffat Tunnel was never so near a complete and final collapse.

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[240] Idem. May 12, 1922, to January 7, 1925.

[241] Report of V. A. Kauffman, Resident Engineer, West Portal, to General Manager Lewis, February 5, 1925.

[242] Statement of Cash Receipts and Disbursements, Moffat Tunnel Commission, May 12, 1922, to July 7, 1925.

Attorneys, bankers and engineers were called into conference. Meeting after meeting was held, and the situation was analyzed from every possible angle. Bond houses would not listen to any proposition for an additional loan until the legality of the Commission's course was established beyond peradventure of a doubt. After months of negotiation and conference the most noted bond attorneys in the country upheld the contention of the Commission attorneys that the Act conferred upon the Commission power to issue supplemental bonds, and made it mandatory upon that body to complete the tunnel at any cost. Storey, Thorndike, Palmer and Robinson of Boston, and Pershing, Nye, Fry and Tallmadge of Denver were the firms that gave favorable opinions upon this course, and the financial program was then outlined upon which all future bond issues were authorized. Thruout these negotiations Grant & Company of New York took an attitude very helpful to the Commission. The negotiations had been carried on with invincible secrecy, and the general public received no inkling of what was in progress until the issue was sold.

There was an immediate uproar from those opposed to the tunnel, and threats of legal proceedings were freely made, but these did not materialize. However, steps were taken to place an opposition ticket in the field at the forthcoming Tunnel District election in July. Judge Henry Bray was then sitting in the West Side criminal court and a grand jury, which has been publicly termed a klan jury, was then in session. It summoned Secretary Leckenby of the Commission to appear before it to answer interrogatories in relation to the actions of the Commission and its expenditure of District funds. Attorney Erskine R. Myer volunteered to appear before the body and give any information desired; indeed, he insisted upon being summoned, but the jury refused to hear him. Under all of this bluster an amusing game of political chess was being played, which a narration of the circumstances will reveal.

The Tunnel Act provided that candidates for the offices of commissioners might have their names placed upon the ballot at the forthcoming election by filing petitions of nomination, signed by a certain number of tax-paying electors, and that these petitions must be filed at the office of the Commission secretary. This was incorrectly interpreted by the opposition to mean personal service upon the secretary.

When Secretary Leckenby appeared before the grand jury he took with him all the records in the Commission office; so many, in fact, that it would have required months to peruse them. His examination lasted most of one day and, as he stepped from the West Side court house and started down the steps, he was handed the nomination petitions of five men who desired to run for commissionerships: J. H. Cole and O. W. Hooker from the Western Slope, and Frederick A. Van Stone, George O. Marrs and F. C. Murchison from the Eastern Slope of the Divide. As a matter of fact the Secretary took the petitions to his office and left them, but the method of service constituted an illegal filing and the candidates were so notified.

A mandamus proceeding was then brought in Judge Henley A. Calvert's division of the district court to compel the Commission to place the names of these candidates upon the ballot, to appoint certain judges of election and follow certain prescribed forms in holding the election. Judge Calvert heard the case July 7, 1925, and handed down a sweeping opinion upholding all these contentions and ordering the names upon the ballot. This decision was given at two o'clock in the afternoon. At ten o'clock the next morning the entire record of the case had been completed by the Commission attorneys and filed in the Supreme Court on a writ of error proceeding. Attorneys and

Chas. H. Leckenby

stenographers had worked all night to accomplish this herculean task and the opposition was completely dumfounded by the result. The Supreme Court of Colorado gave a hearing this same day and reversed Judge Calvert, holding that the petitions were illegally served, but ordering that the names of the Western Slope candidates be placed upon the ballot. There was no contest in the eastern division of the tunnel district, and the three commissioners east of the Divide were re-elected almost unanimously. On the Western Slope Leckenby and Wheeler defeated the aspirants three to one.

About the same time the grand jury returned a report to Judge Bray that there had been no apparent neglect of duty or criminal act performed by the Commission, but that it had used poor judgment in expenditure of funds. Attorney Philip Van Cise and President Robinson immediately appeared before Judge Bray and had this improper comment stricken from the report. Thus was brought to an end a critical situation that might have brought to final defeat the aspirations of northern Colorado for a transcontinental line thru the Divide west of Denver. The only difficulty encountered in placing later bond issues was that of convincing bond dealers that the District was financially responsible. This was due to the comparative novelty of the improvement district idea. The only previous experiments in this line had been at Dayton, where the plan was successful, and in the Everglade improvement in Florida, where it had resulted disastrously. The latter example was cited each time that the Commission sought to place bonds, yet, in the face of this, Moffat Tunnel bonds were floated at an average of five and one-third per cent.

Compared to conditions encountered on the western side, engineers at East Portal were faced by no serious difficulties until February 14, 1925. On that date the first big flow of water occurred when a six-foot seam was tapped near Station Twenty-four.[243] From this seam sprays of water gushed at the rate of eighteen hundred gallons a minute. The east tunnel had not then reached the apex and the water was diverted thru a cross-cut to the railroad tunnel and followed the established gradient to the portal without serious damage beyond a temporary interruption of work. For several days the underground river flowed hip deep, but in the course of a month the flow diminished to one hundred fifty gallons per minute. On the east side of the Divide crest, eleven hundred feet above the tunnel, were several beautiful little glacial lakes, occupying cirques carved by ice-action in ages long gone. These were given the name of Crater Lakes by early settlers, to whom every similar depression indicated an extinct volcano. A fissure connecting with one of these lakes proved to be the source of trouble. An inspection party climbed the snowy hillside to Lower Crater Lake, placed chloride of lime in the water, agitated it by an explosion of dynamite and awaited developments. Very soon the chloride appeared thru the leak in the tunnel. Instead of being bottomless, as this lake was reputed to be, it proved to have a depth of nine feet.[244]

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[243] Report of Burgis F. Coy, Resident Engineer, East Portal, to the Tunnel Commission, March 1, 1925.

The Commission and contractors were greatly encouraged about this time when solid rock was encountered at West Portal. However, costs continued to mount steadily, and on January 1, 1926, a third bond issue of three million, five hundred thousand dollars, with interest at five and one-quarter per cent, was authorized. Grant & Company took this issue also. A further load was taken from the shoulders of the Commission when, on January 6, the Denver & Salt Lake Railroad signed a contract for use of the tunnel. The contract provided for a lease by the railroad to cover a period of fifty years, with the option of renewal for an additional forty-nine years. The company agreed to pay sixty-six and two-thirds per cent of all interest and principal of indebtedness outstanding, *i. e.*, of the first two bond issues; also all operating and maintenance costs of the railroad tunnel.[245] The Commission expected the City of Denver to take care of the remaining one-third of indebtedness mentioned in return for use

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[244] Hitchcock, *op. cit.*

[245] RENTALS OF MOFFAT RAILROAD AND WATER TUNNELS:

First 16 Years—$345,000 annually	Railroad Tunnel	
Next 20 Years—$536,740 down to $320,660 annually		
Last 10 Years—$266,166 down to $187,416 annually		
First 16 Years—$172,950 annually	Water Tunnel	Contract not yet signed by City and County of Denver
Next 20 Years— 223,350 annually		
Last 10 Years— 113,395 annually		

of the water tunnel, but negotiations were held up for many months. The railroad contract gives the Moffat Road authority to sub-lease the tunnel to other roads.

Workers from East Portal passed the apex of the tunnel in November, 1925. This was regarded as a distinct triumph, but disaster of crushing intensity soon was to follow. It seemed that every device of mechanical ingenuity, every time-saving expedient, was promptly overmatched by an intelligent and malignant force within the bowels of the mountain.

On February 28, 1926, in the center heading of the East Portal railroad tunnel, a new water course was cut that released three thousand, one hundred gallons of water per minute.[246] A round had just been fired and the mucking crew had cleaned up the scattered rock by hand preparatory to advance of the mucking machine, when the muck pile suddenly began to swell as tho alive. Almost instantly water spurted out in streams, and drillers and muckers were forced to flee for their lives, abandoning the drill carriage in the adjacent cross-cut. In a few minutes the railroad tunnel had been filled three hundred feet back of the breast. The water then ran thru Cross-cut Ten and filled the water tunnel to the apex, one thousand fifty-four feet back of the railroad heading face, or point of the flood's origin. The difference in elevation between this point and the apex was ten and three one hundredths feet.[247] With the water came a mass of fine running silt that deposited for twelve hundred feet. This flow continued unabated for five or six days, then dropped to fifteen hundred gallons per minute. All the water flowing over the apex was discharged by gravity, but the workings west of the apex were flooded and could not be operated. Two electric centrifugal pumps, each capable of discharging two thousand gallons per minute, were ordered, and upon arrival placed upon flat cars. Twelve hundred feet of discharge pipe was laid and the cars moved forward. The workings were unwatered, but before drilling could be resumed the elements joined forces with the mountain to baffle the engineers. On April 21, during the course of a blizzard that gathered ominously upon the Divide and swept into the canon of the East Boulder with a fury that drove men to cover, snow and wind broke the power lines. The pumps immediately ceased operation and the water began to mount rapidly in the tunnel. Sumps had been dug for the pumps and they had been given permanent mounting. They were hastily pulled, placed upon flat cars and hauled over the apex to safety. Working without rest or sleep, linemen for the power company repaired the break and, ten hours later, power was available. By this time the water had filled the headings to the apex and was running out thru East Portal. For the second time the pumps were mounted upon flat cars, moving into the receding flood as the water was lowered. When conditions were ready for a renewal of drilling, the current failed again. This time the water rose so suddenly that one pump was submerged before it could be moved, placing it out of commission until uncovered by the other pumps. Not until April 27 could work be resumed in the headings. Air pumps were run there, relaying the water to the centrifugal pumps, which lifted the water over the hump. The tunnel was unwatered in four and one-half days, men working to the waist in water. The silt, which had been moved up the tunnel by the floods, had packed and become as hard as rock, and provided a difficult and tedious job of mucking. The seam had to be close-timbered on the sides, back and face. Other seams gave a steady flow of eleven hundred and fifty gallons per minute, but the pumps held this down successfully.[248] No progress was made in the heading from whence the flow came between February 28 and May 25.

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[246] Report of George Lewis to the Tunnel Commission, April 12, 1926. Also Hitchcock, *op. cit.*
[247] Idem.

What these disasters meant in delay to work and increase in cost may be gathered from the tone of President Robinson's semi-annual report in July, 1926. "The conditions encountered since my January report," he wrote, "have been very grave. The water at East Portal and the soft ground conditions at West Portal have continued to delay progress and greatly increase costs. The additional cost of timbering alone occasioned by the soft rock amounts to about two million dollars. The first estimate of bad ground made by our engineers and geologists was one thousand, five hundred feet. This was later increased to eight thousand feet. Our present estimate is that when the tunnel is completed we will have nearly three and one-half miles of timbered tunnel."[249]

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[248] Hitchcock, *op. cit.*

Aside from the delay in operations, the water flows made necessary another unforseen contingency. Concrete gutters had to be laid to carry off the water. The engineers made the most of this necessity by so constructing them that not only did they convey water, but they served as footings for plumb posts. In the report just quoted the cost of these gutters up to that time had been fifty thousand dollars.[250]

"Our additional costs are by no means measured by these two items" (timbering and gutters) wrote President Robinson. "Conditions have been so serious that only by the utmost skill and ingenuity, under difficulties that were all but overwhelming, has the work been pushed stubbornly on to what we are determined will be ultimate success."

During December, 1926, cost of construction took an enormous leap, exceeding the contractors' upset price in the water tunnel for the first time. Costs had averaged twelve dollars forty-nine cents per cubic yard in the water tunnel and five dollars sixty-two cents in the railroad tunnel, but for this month they averaged twenty dollars fifty-five cents in the water tunnel and eight dollars eight cents in the railroad tunnel. For the preceding six months pumps had been kept going twenty-four hours a day to handle the continuous flow of water.

The genius of the engineer could hold in check the ceaseless flow of underground rivers, and baffle the moving mountain that flowed like a viscous fluid between the closely timbered arches; but nothing could dam the steadily mounting flood of expense that pressed upon the Tunnel Commission with crushing weight. A curious irony of fate seemed to parallel the history of the Moffat Road with the history of the Moffat Tunnel. The Mountain rumbled with derisive laughter.

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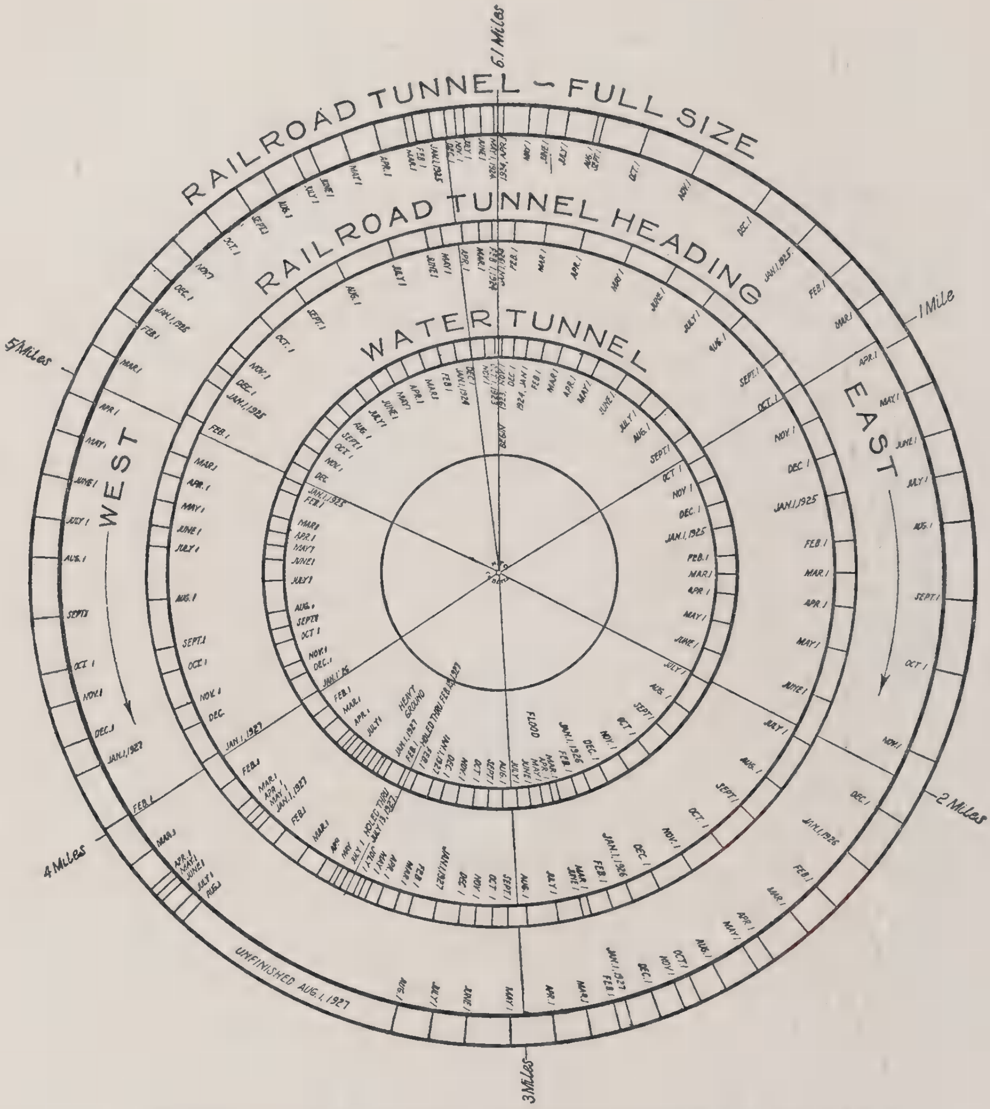
[249] Statement of Cash Receipts and Disbursements, Moffat Tunnel Commission, May 12, 1922, to July 7, 1926.

[250] This gravel was hauled from Denver, engineers having been unable to locate a satisfactory gravel bed near the tunnel.



MOFFAT TUNNEL PROGRESS CHART

MONTHLY PROGRESS CHART OF THE MOFFAT TUNNEL
WATER TUNNEL, MAIN HEADING AND ENLARGEMENT

W. N. W. BLAYNEY

CHAPTER III

SOFT GROUND AT WEST PORTAL—APPALLING GEOLOGIC CONDITIONS—TIMBERS ROTATE AND SPLINTER—STANDARD METHODS FAIL—STEEL WALL-PLATES AND DOUBLE TIMBERING—GEORGE LEWIS BECOMES GENERAL MANAGER—INVENTS LEWIS GIRDER, SALVATION OF THE TUNNEL — OTHER TIME-SAVING EXPEDIENTS — THE CALL-SHIFT—STRATEGY MAKES IT SUCCESSFUL—EXPERIENCED MINERS UNOBTAINABLE—THE BIG CAVE-IN —A DRAMATIC FIGHT AGAINST DISASTER—HEROISM OF THE WORKERS—WATER TUNNEL NEARS CONTACT—WEST PORTAL CREW HOLES THRU—"WHO IN H—L BUILT THIS TUNNEL?"—THE MOUNTAIN PROTESTS—PRESIDENT COOLIDGE TOUCHES KEY—COLORADO AND UTAH SHAKE HANDS IN TUNNEL.

SERIOUS as were the delays caused by water flows on the east side of the Moffat Tunnel, they were in no wise comparable to the trouble, attributive to soft ground, encountered at West Portal. The relative magnitude of the problems at the portals may be fairly measured by the proportion of tunnel driven from each side of the Divide. East Portal crews drove approximately sixty per cent of the total distance; West Portal crews about forty per cent. Had the hard gray granite east of the crest been met thruout the construction period the work would have been completed and trains operated thru the bore in 1926.

The difficulty arose as a result of extraordinary geologic conditions on the west side. In the beginning, it was believed that the western slope consisted of a solid core covered by an immense glacial drift, and upon this theory geologists predicated their opinion that fifteen hundred feet of soft ground would be encountered. Excavation had revealed a far more appalling condition. During seismic disturbances that had upthrust the Rocky Mountains many millions of years ago, this western side had been shattered until innumerable faults existed. Surface water, finding its way along these channels, had saturated the ground to an unknown depth. Certain indications remain that immense underground cisterns, holding large bodies of water, may have been formed by this percolation of the ages. The shattered ground extends eastward beyond the crest of the Divide, a total distance of three and one-half miles from West Portal. The rock more commonly encountered here was biotite gneiss, called by the early Colorado miners metamorphic granite. In certain zones, talc seams were found, while the heaviest ground actually flowed under the enormous pressure. This condition led to the grimly humorous remark by F. C. Hitchcock that "it seems the softest part of the Rocky Mountains is in the middle." Small wonder, then, that ordinary timbering methods failed to hold this slipping, sliding, squeezing mass, that oozed between timber sets and cracked heavy timber like match-sticks.

Obviously, it would have been the part of prudence to have tested the substrata with diamond drills. The Commission did sink a number of test pits at West Portal and, as hard rock was encountered, the outlook seemed promising; but after excavation had commenced it was discovered that the pits had ended in huge boulders instead of in a solid rock core. The Commission was hampered by lack of funds for preliminary investigation. Had money been available in 1922 diamond drilling could have been done and the true condition might have been ascertained, but no money was forthcoming until after the first bond issue had been sold, and interest charges were so heavy that the Commission felt it obligatory to proceed with construction at all possible speed. Possibly no work of equal magnitude has ever been undertaken in which there was so complete a lack of money for preparatory work.

Tunnel progress in soft ground is limited entirely by the speed with which timbers can be set to hold the roof and sides in position. The engineers soon found it necessary to drive top headings at West Portal instead of the center headings used on the east side in solid granite. These headings were driven from the cross-cut on a rising gradient of five per cent, later reduced to two per cent. The former grade is the steepest that can be negotiated by a storage battery locomotive hauling a muck train, while the lesser grade is the heaviest upon which the mucking machines can operate. After the drillers and muckers had completed their operations, the timber crew placed temporary posts and lintels of lodgepole pine. The heading was next enlarged on the sides, twelve-by-twelve-inch arch segments of tough Oregon fir placed in position, resting upon wall-plates of the same material, and these, in turn, were supported by short batter posts. The ordinary twenty-four-inch steel needle bars forty feet long, used in modern tunneling operations with success for many years, were placed in the headings, supporting the wall-plates by side-arms; after which the bench, or tunnel section below the arch, was removed in one or two operations. Permanent plumb posts, twelve-by-twelve inches in diameter were then placed under the wall-plates. In order to have room for timbering operations, a certain amount of overbreak, or excavation outside the neat line of the tunnel, was necessary. The cavities left were filled with cord-wood, the interstices of which were shot full of grout. In time, earth pressures against the tube so constructed caused the ground to arch, or set permanently.

During 1924 conditions grew steadily worse at West Portal. The twelve-by-twelve plumb posts rotated under pressure, or were bowed inward until they splintered or cracked. The wonderful toughness of the Douglas fir was demonstrated many times when posts were broken from side to side, yet the individual fibres held and prevented a collapse until the replacement crew could insert new posts. Roof pressures drove the ends of the arch segments into the wall-plates, flattening them until they measured no more than six inches on one diameter. It became necessary to keep a follow-up crew constantly at work replacing broken and twisted sets with new timbers. Timbers eighteen by twelve inches were tried with no better success. By this time engineers and contractors were badly worried. Old and tried tunnel methods failed one by one under the crushing weight of the mountain. Relief was afforded thru a suggestion made by D. W. Brunton, a member of the board of consulting engineers, who recommended the use of steel I-beam wall plates. These prevented settlement, due to flattening of the wooden wall-plates, while the flanges on the beams eliminated the rotating movement of plumb posts and arch-segments.

However, the nature of the ground steadily became more threatening and the timbers continued to splinter and break. From two and three-foot centers the timber sets were brought more closely together. Fourteen by twenty-four-inch timbers gave way under stress, and finally double timber sets, placed side by side, or skintight in tunnel parlance, were brought into use. Twelve by eighteen, or fourteen by twenty-four-inch timbers formed the outside ring, twelve by twelve timbers the inner ring.

The timbers were set only with the most laborious effort and with an excessive expenditure of time, and when the largest sets failed and the old needle-bar method of holding wall-plates proved inadequate, something akin to despair settled upon the workers. Many of the best timbermen and miners quit the job, discouraged by lack of progress. Engineers, contractors and miners all gave their utmost thought and attention to the problem before them, searching in vain for some method to prevent caving of the roof.

Early in 1925[251] George Lewis, assistant to the Commission president, was appointed general manager of the Moffat Tunnel. A mine manager of long experience in the Cripple Creek district, he brought to the work an inventive turn of mind and great executive ability. Like all the tunnel workers of high or low degree, he had been seeking an answer to the increasing rock stresses, the one form of pressure that cannot be calculated with certainty by mathematical knowledge. His was a staggering responsibility, but he proved to be the man of the hour and rose to the occasion, inventing the Lewis Traveling Cantilever Girder—the outstanding mechanical apparatus given to the world by the Moffat Tunnel.

The idea came as an inspiration on a night when the engineering force at West Portal had gathered in the Administration building to discuss the discouragements of the day. Conversation had lapsed gradually as the hopes of the engineers sank steadily toward the zero point.

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[251] Appointed by resolution of the commission, January 20, 1925.

That they would finish the tunnel none doubted, but when—none dared to predict. One by one they left the conference and went to their rooms. Lewis was among the last to retire. He was lying in bed, wide-eyed and restless, when a picture flashed upon his brain. He saw, in memory, a house being moved on dollies and jacks near Denver's Civic Center. The summer before, while on his way to the Commission offices, he had paused to watch the operation, and had idly wondered then at the mechanical contrivance, apparently so slight and simple, that could uphold a weight so great proportionately. The thought occurred to him that, perhaps, this principle might be developed to hold the tunnel arches in place until permanent supports could be placed beneath them. Jumping from bed, he roused the engineering force and tersely explained his idea. There seemed to be a chance. All the rest of that night the force at West Portal labored over the problem, discussing each point pro and con, figuring stresses, placing upon paper the sketch of a machine that it was hoped might defy the mountain. Hardly had daylight come when Lewis, plan in pocket, sped toward Denver in a fast motor car. Arriving at the Commission offices, he invited the criticism and suggestions of the office engineer, Clifford A. Betts. Point by point the plan was analyzed, a suggestion made here and there, a new and more finished drawing prepared.

Revolutionary ideas in the sciences always meet skepticism, for science is based upon demonstrated fact. Lewis encountered this reception when his plan was submitted to the Commission. The machine would be expensive—all known methods of holding wall-plates had failed—experienced engineers could guaranty no better way than the one long in use. Such were the arguments used. But in selecting their new general manager the Commission had chosen one accustomed to meeting emergencies, one who would not admit the impossible. With supreme confidence Lewis quietly pressed his plan, and concluded with these words:

"Gentlemen, let me build this machine. I believe in it. If it does what is expected, the Tunnel District will pay for it gladly. If it fails the Commission can take a proportion of my salary each month until the cost has been met."

The American sporting instinct which brought about this offer won the Commission where argument had been ineffective, and permission was given to construct the first Lewis Girder. The inventor was far from independent financially; in fact, was dependent upon his salary; but he had fallen heir to that dogged and undaunted spirit that built the Moffat Railroad and Tunnel, manifested time after time by the humblest laborer on the job. It is no more than sound psychology to say that this was the spirit of David H. Moffat, potent in death as it was during the life of the builder. Neither is it awarding too high praise to credit the girder as having been the salvation of the Moffat Tunnel.

The Lewis Girder is an adaptation of the needle-bar principle, used to support arch timbers while excavating the bench, but multiplied in efficiency many fold. Not only will it sustain greater stresses and hold wall-plates more rigidly in position, but it may be moved ahead on its own track without being dismantled. All previous cantilever bars have had to be torn down and rebuilt for each operation, with excessive loss of time and heavy expense. Placed in the top heading, so as to sustain sixty feet of roof, the Lewis Girder permits an air-shovel to excavate beneath it to the full size railroad tunnel at one operation, instead of in two benches and, at the same time, apparently will hold any ground. The girder will overhang from fourteen to twenty feet of excavated tunnel without showing distress, while settlement in the overhanging section rarely is more than a fraction of an inch.[252] On one occasion a section of the roof fell upon the Lewis bar during timbering operations and, while it bent one of the forty-two inch steel girders upon which the cross-arms rest, the machine prevented a cave-in. When the weight had been removed the steel sprang back to its normal position.

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[252] C. A. Betts, Office Engineer of the Commission, has given the following description of the machine: "The new needle bar consists of two 65-foot steel girders, 3½ feet in depth, tied together by rigid struts and braces and carried on dollies running along steel channels placed on 12-inch by 12-inch stringers resting on the bench, but it is designed to cantilever to the rear beyond the end of the bench a maximum distance of 20 feet, where it serves as a support for the arch timbers while the shovel removes the bench and the posts are being set. The roof load is transferred to the girders by means of cross-arms, suspended from these girders by stirrup hangers which extend beneath the wall-plates. The slack is taken up by 15-ton screw jacks. When excavation has proceeded to the maximum 20-foot overhang of the needle bar, it is moved ahead to a new position. This new needle bar carries an endless belt conveyor between the girders so that muck from the 18-foot by 10-foot widened heading into which the machine must move for the enlarging operation, can be carried out beyond the bench and dumped thru a chute into waiting cars in the completed tunnel. This feature has made the Lewis needle bar adaptable to the heading and bench method of tunneling, as well as to the service tunnel and cross-cut method where excavation from the heading was completed thru the cross-cut ahead of the bench. Such attachments to the girder as electric hoists for raising posts, light wiring and piping, add to its convenience and indicate its wide range of use.

The first Lewis Girder was installed at West Portal in March, 1925. Cost accounts had shown that labor charges in the railroad tunnel at West Portal for enlargement during December, 1924, and January and February, 1925, had averaged three dollars and sixty-one cents per cubic yard. After installation of the machine, a reduction to three dollars and thirteen cents per cubic yard was made during the first fifteen days in March, while a further reduction to two dollars and twenty-four cents was made during the last fifteen days of the month. The average cost of placing plumb posts under the new method was reduced from fifty-nine dollars and fifty-six cents to forty-nine dollars and five cents in heavier ground. More important was the fact that time for a cycle of enlargement operations was lowered from twenty-three hours in heavy ground to thirteen hours.[253]

Various other expedients to reduce the time of operations and lower costs were initiated under the new management, chief among which was inauguration of the alternate system of working twin headings, described in a previous chapter, but introduced in July, 1925. This was used with pronounced success as long as East Portal remained in hard rock.[254] The installation of a low pressure blower in the blacksmith shop to supplant compressed air affected an appreciable saving.[255] A simple air-hoist, invented by Chief Inspector Orren Allen, which operated upon a bar attached to the sidewalls, made it possible for one man to lift muck cars from the loading track without resort to switching operations. Construction of transfer docks at portal entrances and within the tunnel, permitted trainmen to dump an entire train of small cars at once, instead of spotting one or two cars at a time, and thus shortened the operation from fifty to fifteen minutes.[256]

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[253] Report of George Lewis to the Tunnel Commission, April 10, 1925.

[254] Idem. August 1, 1925.

[255] Cost reduced from $800 to $36 per month. Report of Orrin Allen to the Tunnel Commission, March 30, 1925.

[256] Idem.

Most interesting as a study in psychology was the inauguration of the call shifts, a Moffat Tunnel development never before used in tunnel construction. Soon after Lewis had assumed his duties he made an analysis of the shift method in vogue, assisted by V. A. Kauffman, then superintendent for the contractors at West Portal. The time-honored custom, followed until that date in the Moffat Tunnel, had been to work men in three shifts of eight hours each. Each crew was expected to drill a round, blast, muck and timber, or to accomplish as many of these labors as possible within the shift. Lewis came to the conclusion that better results could be obtained and time saved if the shifts were called for special purposes. From this decision developed the "call-shift," members of which were expected to perform a specialized job, whether of drilling, mucking or timbering, and to finish that job before leaving the tunnel. The plan was based upon the theory that operations would not be interrupted at critical periods and that the men, having an added incentive, would work faster than before. Because of the heavy bond issues outstanding, speed was imperative. Under the call-shift method crews are called by telephone when wanted inside the tunnel. They receive a full eight-hour compensation for completing the job assigned them, whether it takes three hours or fifteen. But they are paid overtime for every hour over eight.

The general manager believed that the men would welcome opportunity to reduce their shift time, but like most innovations the experiment failed. Instead of speeding operations it delayed them, for the men began to play for overtime pay, and progress was delayed. Sorrowfully Lewis ordered the plan discontinued, reinstated the regular eight-hour shifts, but instituted much stricter supervision. This failure was a severe disappointment to the general manager and his assistants, for they had hoped, by co-ordinating the efforts of eight hundred to one thousand men, to attain the precision, the power and the drive of a great machine. They were forced to the conclusion that the individual variant in human nature made this practically impossible, at least for the Moffat Tunnel. No labor disturbance had occurred since the inception of the work, and those in authority could not take the chance of bringing one about thru unwise handling of the men. Then a strange thing happened. One by one, at first, then thru committees, the workers approached their superintendents and requested resumption of the unpopular call-shift. By slow mental stages, slow because of their distrust of employer innovations, the men came to the realization that the new system might be as beneficial to them as to the Commission. The general manager had been a representative in the state legislature of Colorado, where he had acquired political craft. To have acceded immediately might have renewed suspicion and resulted in a second and fatal miscarriage of plans. He employed strategy.

"By no means will the call-shift be reinstated," was the word sent back. "It has been tried out and proven a failure. The old method is more satisfactory."

This attitude served its end and the pleas of the men were redoubled. After a sufficient display of reluctance the call-shift was re-established with many expressions of doubt, and with the reservation that the men demonstrate its value speedily. From that time until completion of the tunnel the system was used with pronounced success from all viewpoints. Many of the shifts, working under high pressure, completed their task and were out of the tunnel in three and one-half hours. The men learned that the shorter the shift the more calls they would receive, and instead of thirty days' pay in a month many of the workers received from thirty-six to forty days' compensation in that period, while the cost of labor to the District was noticeably reduced because of the better progress. The most interesting phase of the call-shift development from a human standpoint was that the men themselves eliminated shirkers from their ranks. Any man who delayed operations was regarded as an enemy of the shift, and within a few days was compelled to leave the tunnel. Work proceeded with dispatch, the men became impatient of extraneous interference, and did not fail to express displeasure at the intrusion of visitors.

Altho the Commission employed a labor commissioner whose sole duty was to secure and ship workmen to the tunnel, the contractors had the greatest difficulty from inception to completion of the project in securing experienced miners. In the Far East and on the Pacific Coast, where there are constant tunneling operations, experienced tunnel men, known among contractors as "tunnel stiffs," are always available. Since the Moffat Tunnel was off their beaten path, but few of this type appeared during the course of the work. Yet it might reasonably be supposed that Colorado, one of the greatest silver-producing states in the Union, with a mining history as old as the frontier, would have furnished a plentiful supply of miners. Lewis attributed the dearth to the World War. Thousands of experienced miners, too old for the draft, but still capable of many years' hard work, were called into the cities thru the scarcity of young men. They found the ease of city life more congenial than the hard life of a miner, and hundreds whom the manager had known in the Cripple Creek field refused utterly to engage in any form of mining again. The head-lettuce farmers of Grand and Routt counties, unoccupied with their farms in winter, furnished some of the most intelligent and steady labor, altho "head-lettuce miner" came to be a fighting term in the camps.

Isolated, shut off from possible contact with a large city, almost daily experiencing moments big with danger and impending tragedy, the tunnel workers developed many traits of the frontiersman, wherever found. Particularly was this so in their attitude toward their fellow man. A father died. That night a simple notice was tacked upon the bulletin board, and a generous supply of money was available for the widow and children upon the following day. Yuletide came. A fund invariably was raised to buy toys and candy for the Tunnel children—usually so ample that the surplus was used to give a Christmas tree, with all accessories, to some small neighboring town. There were strange incongruities, too, such as one finds on frontiers: A sermon in the recreation hall on a Sunday evening, a prize fight the following evening, an Elks Lodge meeting, a dance, a concert, a moving picture show; and so the nights followed with infinite variety, often with unconscious humor.

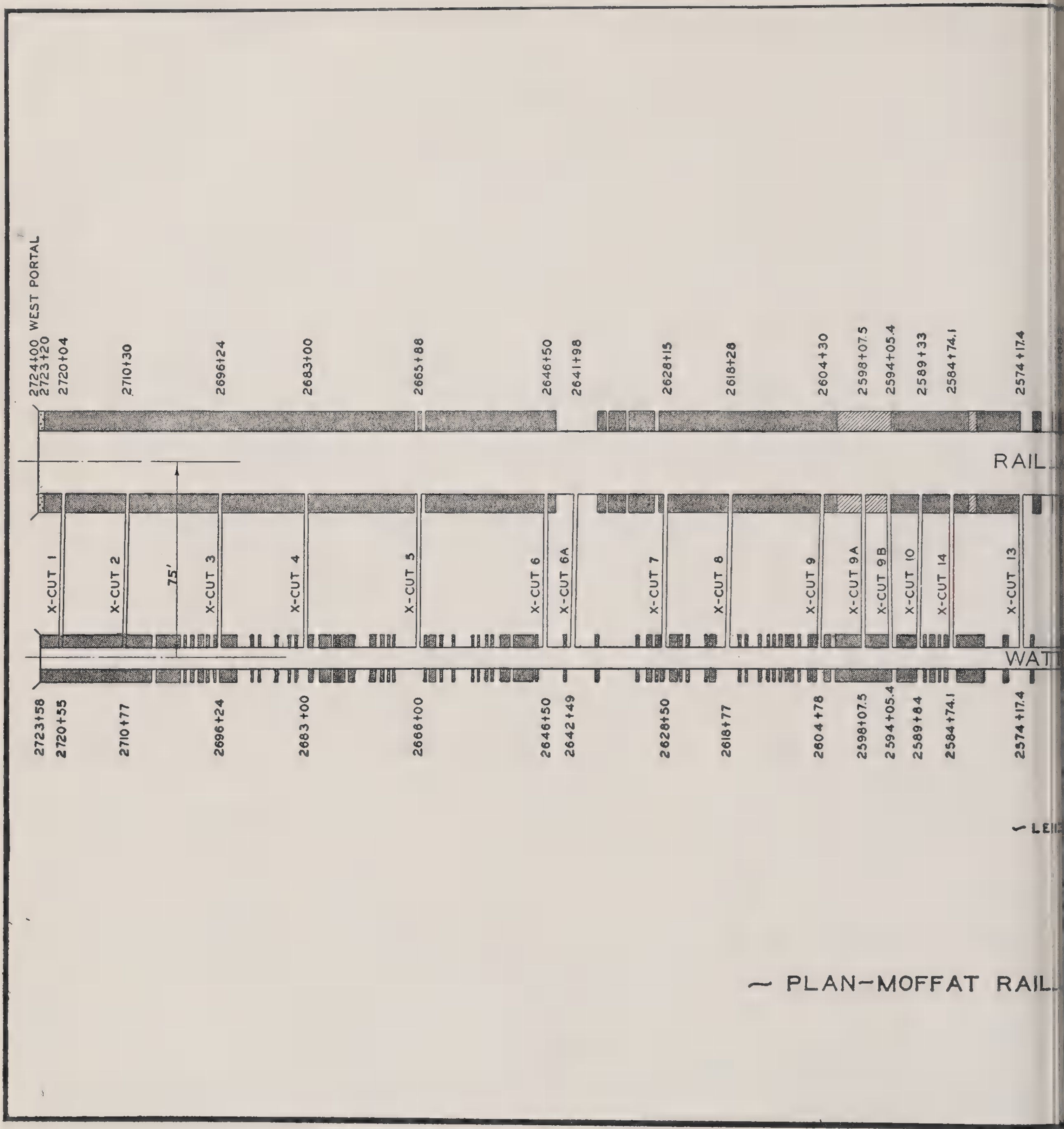
Chas. J. Wheeler

There also were days of great physical and mental stress, when men worked tight-lipped and taciturn, while swift death hung like the sword of Damocles over their devoted heads. Thus it was on the evening of July 30, 1926, when one hundred twenty-five tons of rock fell without warning from the roof in the main heading of the railroad tunnel, just east of Cross-cut Nine, West Portal. The ground was of the character known as "blocky." Ages ago an earthquake had shattered the solid rock here, breaking the granite mass into fragments large and small. Seams and faults ran in every direction. Sometimes these seams were vertical or oblique, plainly visible to the men toiling amid the chaotic material. Sometimes they were horizontal, and tons of rock hung by the slightest bond, ready to drop at the first vibration; yet the seam was invisible to the men below and they could take no precaution.

In such ground, beneath just such a concealed deadfall, a timber crew of six men was working on the day of the tragedy. An eyewitness, some distance away, saw a huge section of the roof fall. There was no warning, no preliminary sound, no dribbling and rattling of small fragments. The mass came down as a hawk swoops, swiftly and silently. A terrific crash echoed and re-echoed thru the tunnel. The six timbermen disappeared. A little rock dust floated in the dim light. A gaping hole, twenty-five feet in depth, appeared in the roof as the dust settled. Men popped from cross-cuts as rabbits from a warren; men swarmed from nowhere, running at full speed to the scene of disaster. Amid the shadows of the great cavity above the wings of death flapped ominously.

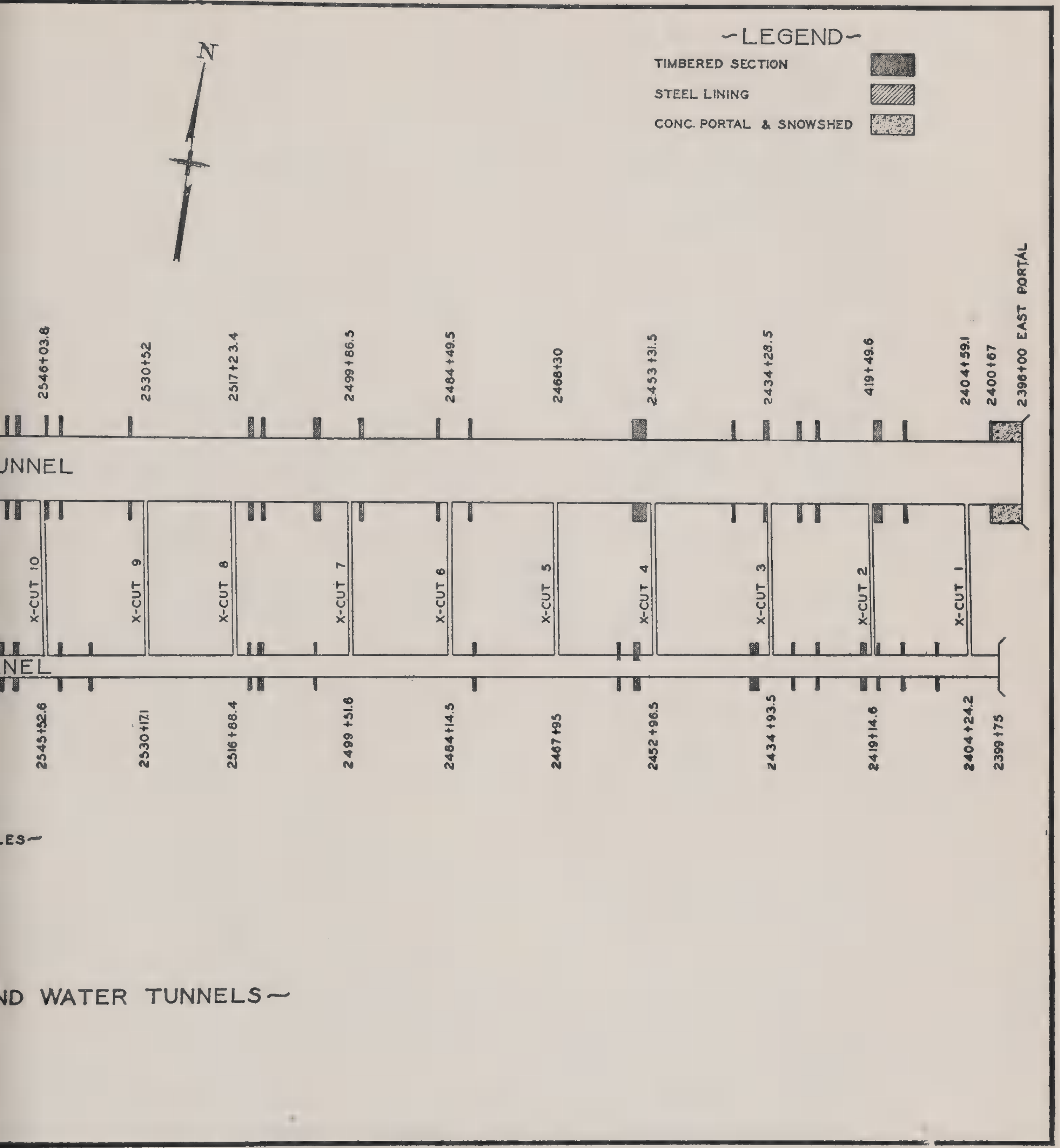
News of the accident was telephoned to West Portal, and superintendents quickly assembled all the men in camp. The situation was stated and volunteers requested. To the last man every worker crowded forward and offered his services, each well aware that not one chance in a million remained for the entombed crew; knowing, too, that the slightest jar might bring down a second rock-fall upon the rescuers.

For seventy-two hours rescue parties worked without cessation,



GRAPHIC CHART ILLUSTRATING THE EXTENT OF SOFT G

Cave In
at X-Cut 9
7/30/26



UNTERED IN CONSTRUCTION OF THE MOFFAT TUNNEL

Total of 28 men killed;
or 4½ Lives per mile

the thought constantly in mind of a death peculiarly shocking and repulsive to any normal-minded man. The first step was to erect a false roof to support the faulted mass above. Crown-bars were lifted carefully into the cavity, cross-timbers hoisted into place. All this had to be accomplished with the nicety one employs in handling nitroglycerine. A heavy timber scraping against ceiling or sides, a careless slip, and tons of rock might be dislodged. The men worked almost in total silence, as tho fearing that undue noise might unleash an avalanche. The only comments were necessary orders, passed from man to man in low tones. Now and then a worker gave out under the excessive labor and the strain and was ordered out of the tunnel by one of those in authority. Invariably, the exhausted miner squared his shoulders and refused point-blank to go. Finally, when the order was made imperative, he would withdraw, bitterly complaining because he was not allowed to remain under the shadow of death. When the last debris was cleared away the crushed and mangled bodies lay revealed upon the floor of the tunnel, one man still firmly grasping a shovel, one holding a pick, struck down before they could sense the danger.

Scenes of heroism such as this accompanied each fatal accident in the tunnel. We have the word of James Cohig, resident engineer at West Portal, that it was almost impossible to induce men to carry on necessary work in other parts of the tunnel while rescue work was progressing. Each wanted to be at the point of danger. There were no plaudits to spur the men onward to superhuman feats in moments like these, no hope of fame or riches or honor, such as buoys up the aviator winging his way across the fog-obscured ocean. The risk was taken simply and bravely. It was all part of the day's work. Here, too, we like to believe, the spirit of Dave Moffat, drawn by the dominant dream of his life, filled the hearts of these humble miners with the grim courage of the frontier.

When the water tunnel headings were eleven hundred feet apart reports of blasting carried from one heading to the other, but the impact of the air-drills did not penetrate the barrier until the wall had been reduced to one hundred fifty feet. These signs of impending contact wrought the miners to a state of suppressed excitement long before the general public knew that the supreme moment in tunnel construction was at hand. The months of hard labor in semi-darkness and the tedious rate of progress made them impatient to knock a hole thru the mountain. Holing thru, the act of driving vibrant steel thru the last stubborn barrier, and the consequent stir of free air between portals, always is the most dramatic moment of tunnel construction to worker as well as to the waiting public, for it marks the triumph of intelligent force over inertia. As distance between the headings lessened, foot by foot, and the rock softened until it could be excavated by hand, brawny arms drove pick and shovel at the blank face of the rock with savage energy. All the long years of preparatory work, the tragic history of the railroad, the vast expenditure of time and energy and money, the memory of comrades sacrificed to the spirit of the mountain, seemed concentrated in the dwindling barrier. Even to the engineers and contractors, who knew to a mathematical certainty that the holes would meet head on, the tension was most trying, but in the public mind, to which the mysteries of engineering must remain a closed book, there was ever a question as to whether the headings would join.

When the headings were about thirty feet apart, according to engineering calculations, pilot drills twenty-three feet long were used every round to determine whether daylight could be found. On February 12, 1927, the headings were twenty feet apart. The Commission had set February 18 as the date for the official holing thru celebration. There was great rivalry between the West and East Portal crews, each craving the honor of breaking through the barrier. The rock was then very soft, and light charges of gelatine were used because of the danger of a cave. The Graveyard Shift, early in the morning of February 12, with twenty minutes remaining of their time, tried a pilot drill without success. Assistant Superintendent C. M. Paul of the West Portal crew then secured a forty-foot bar of five-eighths-inch reinforcing steel. Holding the bar in their bare hands, the members of the shift pushed and jabbed until the opposition suddenly gave way. The Moffat Tunnel was holed thru.

There is an old superstition among tunnel workers that a curse will rest upon the losing crew. The East Portal crew, well aware from sounds that West Portal workers were making some desperate effort to attain victory, seized the bar as it broke the wall and attempted to pull it thru to their side in order to lift the curse. There followed a strange and exciting tug-o-war, miners on either side showing utter disregard of cut and bleeding hands as the bar see-sawed back and forth. However, the West Portal superintendent, wise in the ways of tunnelmen, had bent the rod so that it could not be stolen from his men. As the steel was withdrawn light shot thru the hole, a whiff of air entered East Portal. A gleaming eye promptly was clapped to the hole on either side; then, in triumphant tones, the voice of a West Portal miner roared: "Who in h—l built this tunnel, anyway?"

"We built the tunnel," came the defiant answer from East Portal; and "We did, by gosh," bellowed the West Portal chorus.

Investigation proved that the engineers had made a perfect contact. The line checked within eleven one-hundredths of a foot, the grade within three-tenths of a foot, and the distance within one and seventy-four hundredths feet. The result was a fine testimonial to the accuracy of engineering calculations, and to the division of surveys under supervision of Clifford A. Betts.

In Denver, that same morning, a succession of bombs fired from a newspaper office, carried the news far and wide over the city. Nothing would satisfy the rejoicing populace but that the West Portal holing-thru crew should be brought to the city, paraded thru the streets, and entertained at a special function in its honor.

Arrangements had been made with President Coolidge to explode the final charge by pressure of a telegraphic key on the night of February 18, but the superintendents found it difficult to prevent premature blasting of the remaining wall. The final round was drilled, but not loaded until a few hours before the ceremony. The miners, disdainful of speeches other than the voice of dynamite, were determined to break down the barrier at once, and it was only by the utmost watchfulness that a fiasco was avoided.

As tho in sullen rage at its defeat the majestic mountain gathered all its hidden forces, summoned its allies—the wind and the storm—and vented its displeasure upon the human victor. Snow began to fall almost immediately after the hole had been punched and continued intermittently for four days. Trouble on the power line, due to high wind and snow, shut down the pumps. Within the tunnel a water seam opened and the flood gushed into the headings until the water stood waist deep. For several days before the celebration great difficulty was experienced in keeping the water down, and it was while repairing one of the centrifugal pumps at this time that an electrician was killed. He could not have turned off the switch within the tunnel without shutting down both pumps. Rather than return, in this great emergency, to the portal entrance, where individual controls were located, he voluntarily ran the risk of electrocution. Even so, he probably would have been successful had he not stepped into a deep hole in the tunnel. The water overflowed the tops of his rubber boots, establishing perfect conditions for a current, and when he leaned against a high tension wire carrying twenty-three hundred volts, the charge passed thru his body.

The morning of the eighteenth dawned with the summit of the Divide obscured by a low-lying, ominous cloud-bank. This became darker as day advanced. Shortly before noon, in a last burst of defiance, a terrible blizzard swept down the funnel-shaped valley of the South Boulder. Fine-grained snow particles, riding the gale with furious speed, stung like grains of sand. Then would come a lull in the wind; large, downy snow-flakes, gently weaving thru the air; a glint of sun; and, once again, the ice-lances of the Valkyries. A heavy, white mantle covered ground and trees, mounting steadily until it lay eighteen inches on the level. Each howling burst of wind scooped tons of snow from the ground, snatched it from the weighted boughs of the evergreens, hurled it aloft and filled the air with blinding billows that completely blotted from vision the adjacent mountain sides. All nature seemed to have joined in a conspiracy to defeat the celebration. Grimly and efficiently the men at East Portal went about the task of baffling the storm. Teams were constantly kept on the move to clear automobile roads, while gangs of shovel men cleared the ever-filling paths. On the Moffat Road a huge snow-plow burrowed its way back and forth between the Divide and Tolland. A special train, bearing visitors, was scheduled to run to West Portal before the holing-thru ceremonies. Time after time the rotary burrowed thru cuts that ten minutes earlier it had freed from snow. At each encounter the drifts were as deep as before. The storm was a fitting climax to this epic of man and the mountain.

As night approached automobiles, hauled thru the worst drifts by horse power, began to arrive in camp. The special train had passed in a vortex of whirling snow, and several hours later reappeared. Horse-drawn bob-sleds carried the visitors from the siding to camp. Donning slickers and rubber boots, the party, numbering over one hundred, repaired to the mess-hall and partook of the workers' fare. A man-train was waiting at the water tunnel entrance. The visitors climbed aboard, and the train sped into the heart of the mountain. At Cross-cut Thirteen a radio receiving set had been installed, telephones provided and telegraphic wires laid in order that instantaneous news of the event might be flashed across the country. In an expectant hush the party gathered in the cross-cut, awaiting the touch of the President's hand. Promptly at ten minutes past eight, by pre-arrangement, the electric command sped over the wires from Washington. There was a dull boom, followed by the quivering protest of the mountain. One after another the shots followed, twenty-four in all. The gray smoke-wall drifted up the tunnel, the roar of compressed air was heard, the air cleared once again. Then, as Governor William H. Adams of Colorado and Mayor Clarence C. Neslen of Salt Lake City shook hands to signify the establishment of a new bond between Atlantic and Pacific slopes, there came excited cries of triumph from the breast of the tunnel several hundred feet away. Without waiting to test the overhanging rock, reckless of consequences, the miners from

West Portal came crawling over the muck-pile that rose to within two feet of the roof.

"Who built this tunnel, anyway?" rang the joyful challenge.

"We did," echoed the roaring unison, as the grimy miners clasped hands and slapped one another upon the back. This was the real holing-thru ceremony.

Over the currents of the air that night wave-length after wave-length broadcasted the boom of shots to the world. Strangely enough, the sound was heard more distinctly in certain parts of Canada than in Denver nearby. Speeches by Governor Adams, Mayor Neslen, President Richard Crane of the Denver Chamber of Commerce, George A. Levy, who represented the Commission, and F. C. Hitchcock on behalf of the contractors, reviewed the historic battle to overcome the great barrier, painted glowing pictures of the industrial development to come; dealt tenderly with the memory of David H. Moffat, and proudly with the realization of his dream.

To the average citizen, unversed in tunnel construction methods and terms, the words "holed thru," carried the vision of a completed tunnel; but the triumph was far from complete. This was but a preliminary victory. The most arduous labors, the most dangerous ground, the most trying period of construction lay before the Commission and the men who drove the tunnel. Even as "the tumult and the shouting" died, even as the grotesque mucking machine lumbered into the heading and rooted the last pile of water tunnel debris, preparations were made to drive ahead with the railroad tunnel heading and enlargement operations. Members of the commission, engineers and contractors, superintendents and drillers, muckers and timbermen, soberly resumed their tasks again before the official train had passed from the tunnel into the roaring gale without. They had looked with perfect comprehension at the newly-driven headings, the splintered posts, and their eyes hardened, their jaws set, as they looked.

CHAPTER IV

THE SHEAR ZONE AT CROSS-CUT NINE WEST—PRONOUNCED THE WORST GROUND EVER ENCOUNTERED—STEEL LINING ADOPTED—SWELLING GROUND—HEADINGS INCREASED AND FOUR GIRDERS INSTALLED—RAILROAD TUNNEL HOLED THRU—THE FOURTH BOND ISSUE—TOTAL BOND RECEIPTS EXCEED FIFTEEN AND ONE-HALF MILLIONS—UNPARALLELED EXTENT OF SOFT GROUND—COMMISSION DISPLAYS PUBLIC SPIRIT—CONTRACT TERM EXPIRES—VENTILATION PLANT DECIDED UPON.

THE Moffat Tunnel water bore served well its purpose as an index to the character of ground to be encountered in the railroad tunnel, but when the extremely heavy and dangerous core of the Continental Divide was entered all experience gained in estimating stresses by this method failed. The ratio of pressures in the large and small tunnels changed completely for several thousand feet in the center of the mountain. Ground that could be held with apparent ease while operations were confined to the water tunnel, bowed and splintered every known form of timber sets in the railroad tunnel, due to the larger area of stress.

East of Cross-cut Nine West a shear zone was cut that literally amazed the most experienced tunnel men. F. C. Hitchcock of the contractors has described this ground in technical, tho graphic words.

"This shear zone is a badly shattered serpentine schist broken by innumerable slicken-sided joints and altered dykes of pegmatite, all interwoven with layers of talc. The formation has been dynamically metamorphosed into a mass of weak secondary minerals, and, while quite dry, flows like an extremely viscuous liquid . . . This ground was inspected by expert miners with lifelong experience in Colorado mines, and by many engineers of long experience, and was pronounced by all the worst rock ever encountered."[257]

Only very light charges of dynamite, or no shooting whatever, were required in a goodly part of this zone, and the muck was taken up by hand after the face of the rock had been broken down by jack-hammers and picks. Some headings developed running ground that required the use of crown-bars and breast-boards to hold back the muck while timbering operations were in progress. Rapid advance was impossible under such conditions. While not as dangerous to life as the blocky ground that resulted in the big cave-in of July 30, 1926, it proved extremely deceptive. Thirty days after heavy Oregon fir timber-sets had been placed in position plumb posts and arches began to fail, and within sixty days the timbers would split or break in two.

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[257] Hitchcock, *op. cit.*

One might reasonably suppose that loss of life would have been great under such conditions, but such was not the case. This was due in large measure to the caution of the advance, the Commission having directed that, where life was endangered, time should be sacrificed to safety. The ground was not what is known to tunnel workers as "fast," *i. e.*, it did not cave suddenly. The mountain at this stage always gave ample warning and men who left the job did so because of discouragement over the slow progress rather than thru fear of death. Warning was manifested by a constant dribbling of rock fragments that peeled from the breast of their own volition, or rattled upon the jumbo timber sets in the enlarged tunnel. In the worst ground these sounds were almost constant. One could pry a piece of the rock from breast or wall with his fingers and crumble it to powder in his hand. The men acquired a sixth sense that told them without fail when the rain of earthen pellets foretold danger and when the noise might be ignored with impunity.

The condition described forced the adoption of steel arches, plumb posts and inverts, in one instance for an unbroken stretch of eight hundred sixteen feet between Cross-cut Nine East and Cross-cut Nine-B West. Similar construction for one hundred feet was employed between Cross-cuts Thirteen and Fourteen. During the month of April, 1927, progress in the main headings of the railroad tunnel was only three hundred sixty-seven feet, compared to a monthly average of seven hundred six feet for the preceding twenty-eight months. Even the steel lining began to show evidence of failure, the ends of steel arch segments in some cases having been forced into the fifteen-inch I-beams used as wall-plates. This led to adoption of H-beams, a heavier type of structural steel and one that served the purpose. The plumb posts were rested upon heavy concrete footings, yet the enormous pressure often forced posts in at the base for several inches. Engineers were compelled to make allowance for this movement and settlement of arches.

With the roof and sides firmly held by the ingenuity of man, the mountain switched its point of attack and exerted pressure from the bottom. The floor of the tunnel began to swell and arch—the ground *flowed upward*. To tunnel experts this manifestation, the most dreaded of all pressures because it is the greatest and most difficult to hold, is known as swelling ground. In order to hold the floor in place and, at the same time, brace the plumb posts so that they could not move to the center and cause a collapse of the arch, what are technically known as steel inverts were adopted. These consisted of three segments, bolted together and likewise bolted to the plumb posts, forming a low inverted arch when in position.[258] Wherever the steel lining was used the entire railroad tunnel was covered with concrete, thus giving a solid, reinforced concrete tube, twenty-four feet high and sixteen feet wide.

The value of the water tunnel here was demonstrated to the greatest advantage. The number of cross-cuts was increased in order to give more points of attack. Instead of opening cross-cuts every fifteen hundred feet they were driven within a few hundred feet of one another. At one time, during June, as many as fifteen faces were being worked simultaneously. Three more Lewis Girders, making four in all, were built after the water tunnel had been holed thru, and these were placed in the most dangerous headings. One girder was furnished with a reversible conveyor belt, an air-hoist to lift the heavy steel beams into position, a loading skip at the forward end to handle muck from the heading. Debris was thrown upon the belt at the breast, carried backward thru the machine and dumped thru a chute into waiting cars on the floor of the tunnel. When the steel shift was setting arches in the top-widening operation, beams were hoisted to the belt, its action reversed, and the load was delivered to the men in the heading.

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[258] Arch-segments weighed 100 pounds to the foot. Twenty-inch Bethlehem girder beams, weighing 113 pounds to the foot, formed the plumb posts. Wall-plates, of 24-inch pattern, weighed 80 pounds to the foot, while 12-inch H-beams, weighing 79 pounds to the foot, were used in the inverts.

Progress in this form of construction, as in timbering, depended entirely upon the speed with which steel could be hoisted into position and bolted, but the operation was infinitely slower than timbering. Erection of four plumb posts, as an illustration, often took from twelve to fourteen hours. The steel shift, upon delivery of the plumb posts, would first attach a cable to one end of a beam, the girder hoist would raise this a few feet, the men would shift the recumbent end toward the center of the tunnel, and the order would be continued with wearisome repetitions. In this tedious manner the plumb post at last would be swung clear of the floor, lowered to rest upon a concrete footing, centered and wedged. Perched high upon a wall-plate in the semigloom of the arch, a steel worker would hammer home the bolts. Now and again the sound of shoveling would come from the dark recess forward; anon the conveyor belt would rattle; there would come the deafening clang and patter of stone fragments upon steel as a load of muck shot downward thru a steel chute into a dump car spotted beneath the opening. Timber crews, working in the completed tunnel, spiked to the top segment of timbered arches the California redwood ceiling as protection against locomotive sparks. The handsome concrete portal at the west end was poured, orders placed for red oak ties and one hundred and ten-pound rail, the East Portal ventilation housing and snowshed were completed, all while the slow process of erecting steel lining and pouring concrete within was being executed.

The railroad tunnel was holed thru on the morning of July 7, 1927, by a West Portal crew. This was more or less a routine affair, since the dramatic moment had passed when the water tunnel joined. No celebration was held by the Commission. Public interest flared up momentarily at the news, which followed by one day announcement that a fourth bond issue had been floated.

Before the water tunnel had been holed thru it had become apparent that this issue would be necessitated by the soft ground opened. A misconception prevailed in Eastern financial circles as to progress of the work, just as it prevailed in the Tunnel District. The popular assumption was that the first holing-thru ceremonies had marked, to all practical intents, completion of the tunnel. It proved no easy matter to float the fourth issue for the reason given. President Robinson devoted most of his time during the first six months of 1927 in negotiating the sale, which was finally consummated in June.

The fourth issue totaled two million, seven hundred fifty thousand dollars, and bore interest at five per cent. This was the only issue discounted, the actual receipts to the Commission being two million, six hundred thousand, five hundred dollars. The amount brought total cash receipts from sale of bonds to fifteen million, five hundred forty-seven thousand, four hundred ninety-nine dollars and ninety-five cents. Of this two million one hundred forty-nine thousand, one hundred sixty-eight dollars had been paid in interest up to July 1, 1927, the Commission having been compelled to use part of the proceeds for this purpose because no income from rental could be secured until the completed tunnel was turned over to the railroad for operation.[259]

Final costs of the Moffat Tunnel, of course, cannot be given until work has ceased and the portal camps have been dismantled and sold. An unusual feature has been that the Commission has had to pay interest from the proceeds of the bonds during the period of construction. The Moffat Tunnel also developed miles of soft ground, as compared to a few thousand feet in other tunnels. The amount of the first bond issue was fixed by legislative enactment at six million seven hundred twenty thousand dollars before the Tunnel Commission was created and is not a Commission estimate for that reason.

While the total cost of the Moffat Tunnel will be two and one-half times the legislative estimate, the history of practically all transporta-

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[259] Moffat Tunnel bond issues were as follows:

First issue	$6,720,000.00 at 6%	Premium, $214,999.95
Supplemental (1925)	2,500,000.00 at 5%	Sold at par
Supplemental (1926)	3,500,000.00 at 5%	Sold at par
Supplemental (1927)	2,750,000.00 at 5%	Sold at $2,612,500.00

tion bores ever constructed shows an excess over the first estimates. Rogers Pass was a notable exception, as the contractors finished within the time-limit and collected a large bonus. There never has been a transportation bore driven, however, unless we except the Cascade Tunnel to the present point of penetration, where such favorable rock conditions were met. Many assumed at the start of operations that the Moffat Tunnel contractors would encounter the same type of rock as was found at Rogers Pass, because both tunnels are located in the Continental Divide of North America. Actually, these conditions were as far apart as the poles.

The most highly standardized methods in tunneling have been developed in bores beneath rivers, harbors or sea-channels, where the steel-shield method is used, and a hollow steel tube constructed to exclude the water. No other method offers such certain and definite basis for calculation, yet the new Holland Vehicular Tunnel under the Hudson River, originally estimated to cost twenty-eight million dollars, eventually cost forty-eight millions. The Commission had upon its board of consulting engineers J. Vipond Davies, often accredited as the greatest world authority on this form of tunneling.[260]

The unexpected cost of the work placed a very heavy burden upon the Commission, and the influences just described made accomplishment more difficult. To the Commission must be given a large measure of credit for its public spirit in remaining upon the job and giving its utmost to the end, for the thoro and careful manner in which various developments were undertaken, for the unremitting effort to speed the work to an early conclusion, and for the steady persistence with which it pursued its course. The compensation of members, one thousand dollars per year, was nominal and unimportant to any member of the board. President Robinson, as president of the Denver Union Water Company for a long term of years, had been friend and associate of Moffat, and took great personal pride in helping to bring to fruition the dream of the builder. Willcox had been a member of the first tunnel commission, created by vote of the people of Denver, and for twenty-five years had served upon various municipal commissions and boards; Blayney, altho never a heavy investor in the Moffat Road, had been the first to subscribe when the Denver-Steamboat Construction Company was organized to save the Moffat Road from dissolution before Moffat's death. Leckenby, as newspaper editor of Steamboat Springs, had supported the road and tunnel idea over a period of twenty years. Wheeler, more recently come into the field, also had been a consistent supporter of the move to construct the tunnel. The responsibility carried by these men became very heavy indeed, as the work progressed, yet no member of the Commission ever sought to evade complete responsibility, nor hesitated to perform his duty to the district. Unlike many boards of this character, complete unanimity prevailed. The Commission's faith in the future of the tunnel, and of the district to be developed, was in the spirit of the Moffat Road builders. The Commission was made appointive in 1927 by an amendment to the original Act. Senate Bill No. 286, approved March 9, 1927, provided for this change. It was unanimously passed by both houses. Under its terms Governor Adams appointed Robinson and Leckenby to six-year terms, Blayney and Wheeler to four-year terms, and Willcox to the two-year term.

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[260] Mr. Davies was engineer for the Holland Vehicular Tunnel.

When the contract term for construction, forty-six months, expired July 20, 1927, there remained unfinished two thousand, four hundred fifty feet of railroad bench, including one thousand, ninety-six feet of top-widening. While this work was under way, final grading of the railroad tunnel, ballasting and track-laying proceeded in anticipation of train operation. The original plans of the engineers called for electrification, a consummation greatly to be desired, as it would eliminate all question of smoke collection in the tunnel and save time. The initial cost of this work, about four hundred fifty thousand dollars, was considered excessive by the railroad in view of the light traffic prevailing, and since the contract for use provided that the expense should be borne by the railroad, President Freeman elected to depend upon artificial ventilation. The system can be changed at any time in the future. The great depth of the bore below the surface precluded the use of ventilation shafts. Neither could natural air current be relied upon, altho a strong west to east draft passed thru the tunnel almost constantly, due, as some say, to a difference in barometric pressure. The decision was reached to install powerful blowers at East Portal, housing them in a concrete building, from which a large concrete snowshed extends eastward. The ventilation plant will be capable of blowing a current of air thru the tunnel from east to west, or of drawing it from west to east by suction, so that the air will flow in a direction opposite to that being taken by a train in transit.[261] All maintenance charges and upkeep of the railroad tunnel will be paid by the railroad, but the Commission must maintain the water tunnel. Before water can be taken thru the small bore this must be concreted from West Portal to a point beyond the apex, where hard rock is encountered. Until the City and County of Denver signs a contract for its use, however, the District will be called upon to keep the tunnel in repair at heavy annual cost.

The purpose of this work is not to follow construction history of the Moffat Tunnel to final conclusion, so that little more need be said of construction details. The dedication ceremonies, the passage of the first train thru the bore, the development of the Upper Colorado Basin, are matters that future historians must handle. There remains, however, a vital chapter in the history of the railroad, enacted coincidentally with construction of the tunnel—the period of reorganization, or preparation of the Moffat Road for the greater service it is expected to give in the development of new empire.

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261. Thirty-five thousand cubic feet of air per minute will be forced into the tunnel thru a duct leading from a blower in the ventilating plant at East Portal into the side of the concrete snowshed. A mechanically operated door at the portal, which is incorporated into the ventilating plant building, controls the air flow. Two blowers of 500 horsepower and 750 horsepower respectively will be provided, one to be held in reserve for emergency. All control gates will be electrically operated.

GERALD HUGHES

CHAPTER V

IDEAL OF AN INDEPENDENT TRANSCONTINENTAL GATEWAY MAINTAINED—VOTING POOL FORMED TO PREVENT SALE OF MOFFAT ROAD TO ANTAGONISTIC INTERESTS—REORGANIZATION COMMITTEE, WITH GERALD HUGHES AT THE HELM, BEGINS REHABILITATION PROGRAM—SECURES APATHETIC CONSENT OF TRUSTEES—OLD INVESTORS COME TO RESCUE WITH TWO AND ONE-HALF MILLIONS IN NEW CAPITAL—REORGANIZATION BECOMES EFFECTIVE IN 1925—DETAILS OF PLAN—PROVISION FOR DOTSERO CUT-OFF OR EXTENSION FROM CRAIG WESTWARD—SALE OF THE MOFFAT ROAD AND ORGANIZATION OF THE NEW COMPANY—RECEIVERSHIP TERMINATED—CONCLUSION.

AMONG the many desperate battles waged in building the Moffat Road and Tunnel, altho carried on in the background and almost unnoticed by the public, one of the most important and interesting was that to rehabilitate the railroad so that it might be ready to take immediate advantage of industrial opportunities to be afforded by construction of the tunnel, and to fulfill the destiny mapped for the road in the vision of David H. Moffat. The dream and the great accomplishment were Moffat's; his also the greatest sacrifice, for he gave his fortune and life to the cause. During the last few years of Moffat's life, and afterward, when he was gone, a sturdy group took up the fight and drove on across the ranges in the face of the many discouragements we have related during the course of this Colorado epic. William G. Evans, Senator Charles J. Hughes, Gerald Hughes, Senator Lawrence C. Phipps, Col. D. C. Dodge, Henry M. Porter, Samuel M. Perry, William R. Freeman and others maintained the ideal of an open gateway thru their control of the road. When it became fully apparent that no further progress could be made until the problem at Corona had been solved, Evans began his notable struggle to secure a tunnel under Rollins Pass at public expense, until, weakened and aged by crushing disappointments but never broken in spirit, he, too, succumbed, the great objective assured.

Construction of the tunnel in itself was not to solve all difficulties of the railroad. There still remained the great question whether the Moffat Road would survive until a tunnel could be completed; the ever-present doubt whether trains could be operated successfully over the hill in winter; the dubious prospect whether the ill-nourished corporation could climb the hill of financial opposition that must be negotiated before it could lease and operate the tunnel. The physical difficulties, as related before, were solved to some extent by Freeman, but the sinews of war, the finances necessary to rehabilitate a decrepit system, were furnished largely thru the persistence and activity of another man, the youngest of that original group that had launched the enterprise twenty years before.

The guiding genius in the reorganization of the Moffat Road, without which the tunnel might have proved a costly fiasco, was Gerald Hughes, who undertook the monumental task a year or two before construction of the tunnel was begun. And here we may call attention to a fact that perhaps has escaped the reader. Three names are indelibly written upon Moffat Road annals before all others, because they first entered into the story of Colorado's transportation ambitions in the sixties, and have been closely associated with the transcontinental railway dream from frontier days down to the present. First, the name of Moffat, for the banker was the only individual closely associated with this dream from its inception. Next, the names of Evans and Hughes. Governor John Evans and General Bela M. Hughes, together with Moffat, were among the most influential of that group of pioneers who gave Denver and Colorado their first railroad. General Hughes as first president of the Denver Pacific, Governor Evans as one of those who financed its construction. Both used every effort to influence the Union Pacific to build over the range west of Denver. Governor Evans' name and ideals as a railroad builder were perpetuated by a son, who inherited all his sire's vision, strength of will and singleness of purpose—William G. Evans. General Hughes was responsible for bringing to Colorado, during the eighties, Charles J. Hughes, Jr., his nephew, then a young man just graduated from college. Upon the death of Senator Hughes, his son Gerald represented the Hughes interests in the railroad and eventually came to leadership in its affairs. Next to Moffat, Senator Phipps has been the largest individual investor, but the Hughes interests, represented by the investments of father and son, now are approximately the same as the interest of Senator Phipps. The association of these names affords one of the most romantic sidelights in Moffat Tunnel history, and explains in a large measure the indomitable purpose that runs like a golden thread thru the story of the tunnel.

Like the development work of all pioneer Colorado railroads, the struggle to build the Moffat Road always was a personal fight, waged at tremendous sacrifice and suffering; based upon the force of character, the will to do, the plausibility, the dominance and the faith of a few individuals. All of Colorado's early railroad builders suffered severe losses in trying to develop the state with very few exceptions. Perhaps the most notable example of success was construction of the South Park Railroad, in which Governor Evans and Moffat played conspicuous parts, but each of these men, in their later operations, were crippled financially and passed thru great mental trials.

There is little doubt that investors in the Moffat Road could have sold their interests to other railroads upon more than one occasion had they been so minded, and thus saved at least the bulk of their investments. Certainly this was so after construction of the tunnel had been assured. But they were deterred by two things: loyalty to the memory and vision of Moffat, and their desire to insure the destiny of the road as a developer of empire. Had certain roads secured control of the property this purpose could never have been realized.

To guard against the temptation of a favorable financial offer, local bondholders, soon after the receivership had been established in 1917, formed a voting pool, under the terms of which a controlling interest pledged itself not to sell out for a period of ten years. About one year before the Tunnel Act was passed the reorganization committee commenced to function, carrying on its negotiations with patience and persistence while the bore was in process of construction, and concluding them successfully in July, 1925.

The Reorganization Committee, composed of Gerald Hughes, chairman; Lawrence C. Phipps, Jr., and Alexander Berger, one of the early investors, first had to secure the approval of the trustees for the bondholders, the Bankers Trust Company and the Seaboard National Bank of New York. The first approach was unpropitious, because trustees were extremely skeptical of success, and scoffed at the idea. However, they were dealing with men who had met rebuffs for twenty years, men with the one-track idea that the Moffat Road eventually would succeed in giving Denver its first direct transcontinental communication. The tragic story of the railroad was recounted; step by step, its fateful course was traced from its inception in the minds of pioneers; the struggle of Moffat with the railroad kings of the nation, the almost insuperable difficulties of operation, the faith of a large population, the crisis after crisis that had been weathered by grim courage. Wonderingly the trustees listened to the tale and, at last, after long negotiations, relented to the extent of a qualified consent. Rather, it was more of an armistice, a truce on the industrial battlefield. The promise was passed that the trustees would formally approve the plan, but the explicit reservation was made that no further financial assistance, nor even moral backing, need be expected in eastern financial circles.[261]

This rather dubious approval was all that the committee sought. It returned to Denver and began to lay the groundwork for a reorganization plan. Progress by the committee was as slow, as laborious, as stubborn in its way as construction of the tunnel. Passage of the Tunnel Act gave the first ray of hope, but even after that it proved to be a monumental task to revive interest and re-establish sufficient confidence among investors to gain their active support. Individual investors were interviewed and converted, the complicated details of the plan worked out, revised, revamped, until a majority of the bondholders fell in line. Actual cash—two and one-half million dollars—

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[261] Statement of Gerald Hughes to the writer.

SENATOR LAWRENCE C. PHIPPS

was needed to make the reorganization possible. Certain items of indebtedness must be cleared up. Rentals to the Northwestern Terminal Company, which held title to terminal facilities in Denver, had not been paid since the receivership was instituted, and this company itself was in receivership. Pressing obligations, including principal and interest on receiver's certificates, indebtedness to the government, taxes and other incidentals, must be met. The receiver's certificates with interest alone accounted for one million, two hundred thousand dollars. Then, too, funds were needed to improve the roadbed, rehabilitate the rolling stock and make necessary connections with the tunnel.

The situation cleared and a way out was shown when a group of former investors agreed to supply the necessary funds. Four men came to the front with large subscriptions: Senator Phipps, Gerald Hughes, Frederick H. Prince of Boston and Alexander Berger of Virginia. The latter two were not hampered by eastern railroad associations that had closed the doors of Wall Street to the committee, and they showed a highly commendable spirit in thus gambling further upon an uncertainty that had never paid them a cent upon previous investments. A second group of smaller investors made up the quota. This included William H. Freeman, the receiver; Charles Boettcher, and two old personal friends of David H. Moffat, who had first become involved at the time of organization of the Denver-Steamboat Construction Company—George H. Burr of New York and V. A. Eckhardt.

With the necessary sum pledged the reorganization was carried forward to a successful conclusion and became effective during the summer of 1925. There were outstanding at the time First Mortgage Thirty Year Gold Bonds of the Denver & Salt Lake Railroad in the sum of ten million, five hundred fourteen thousand dollars; five per cent Thirty Year Adjustment Mortgage Bonds of the same corporation in the sum of two million dollars, both of which were issued May 1, 1913, when the Erb reorganization was effected.

The new plan provided for elimination of these bonds and their accrued interest, which had amounted approximately to one-half million dollars a year, and which had never been paid in whole or in part; also for transfer to a new company of property of the road, and the issuance of various new bonds, mortgages and stock.

New First Mortgage Bonds were authorized in two series, both to mature in 1950. Series A was issued to pay the obligations indicated above, and totalled two million, five hundred thousand dollars; Series B, in the amount of three million dollars, was not issued, but has been held in reserve, to be used either for construction of the Dotsero Cut-off, or for the Craig extension. At the date of writing no contract has been signed with the Moffat Road by other railroads for use of the cut-off, and we have been informed unless such a contract is signed when the tunnel is placed in operation, the issue will be devoted to the western extension to Salt Lake, thru the Uintah Basin. In order to protect the interest of all bondholders, an issue of eleven million dollars by the new company, the Denver & Salt Lake Railway, was authorized, to be exchanged for First Mortgage Bonds of the Denver & Salt Lake Railroad.[262]

Upon acceptance of the details by committees representing the depositors, the plan was placed in force, and the old company sold at auction August 17, 1926, for three and one-quarter million dollars. Judge Harry S. Class, special master appointed by the District Court of Adams County, Colorado, directed the foreclosure decree. The sale was a formality, Gerald Hughes making the only bid on behalf of the Reorganization Committee. Retirement of the old bonds and formal transfer of the property was consummated December 30, 1926, when Judge Samuel W. Johnson closed the receivership. The new organization took over the property the next day and elected the following officers: President, William R. Freeman; chairman of the board, Gerald Hughes; treasurer, L. C. Phipps, Jr.; assistant treasurer, A. L. Dodd; secretary, D. C. Bromfield; auditor, S. S. Mayer. Other members of the board are: Alexander Berger of Maryton, Virginia; W. C. Carpenter of Denver, and Charles Boettcher of Denver.

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[262] *Reorganization of the Denver and Salt Lake Railroad Company.* Plan and Agreement. Dated July 15, 1925.

Vital as the Moffat Tunnel is to the State of Colorado, it assumes a far greater significance when considered as a national asset, and in this respect its creation is comparable to the march of the Union Pacific Railroad across the continent in the sixties, or to the construction of the Panama Canal. Transcontinental traffic development in America has trended steadily toward reduction of time and distance between the Atlantic and Pacific coasts. Economic, social and political unity, to say nothing of necessity in time of war, depends upon speed of communication—the ruling spirit of the age.

Of all men who have had a clear concept of the situation, perhaps E. H. Harriman was the most outstanding. An industrial genius, far ahead of his time, he early realized that every mile eliminated, every hour clipped from the transcontinental passage, placed trade relations between East and West upon a sounder basis, and strengthened national unity. Unfortunately for Colorado, his plans did not include the state; but he had inherited an existing system, and his clear duty was to maintain its supremacy as the one central trade route. In pursuance of this duty he spent millions to increase Union Pacific efficiency before others had realized the economic soundness of the policy. When it is considered that the business interests of their roads were elsewhere, no resentment can be harbored by the people of Colorado against railroad leaders who opposed the Moffat Tunnel, altho at times their attitude may seem to have taken a very hard form.

Since the wisdom of Harriman's course has become generally apparent, other roads have followed suit. Even now, the Denver & Rio Grande Western, on a much smaller scale, is devoting its energies to improvement of its system by means of line and grade changes west of Pueblo, with the dominant idea that the route up the Arkansas is the natural gateway for transcontinental traffic thru Colorado. While no one will challenge the importance to the state of the Missouri Pacific-Rio Grande gateway, the situation of northern Colorado would not be helped regardless of how effective this southern route might become. As far as the section mentioned is concerned, the only result would be to narrow extent of the retarded territory. Instead of extending from the Union Pacific on the north to the Santa Fe on the south, the belt, without the Moffat Tunnel, would extend from the Union Pacific to the Rio Grande.

The Moffat Railroad, operated thru the tunnel, not only will offer the shortest transcontinental route, but at the same time will constitute an open gateway controlled by no single road; nor, thanks to the foresight of those who drafted the Tunnel Act, can this gateway ever be closed. The tunnel remains forever the property of the District. The Burlington and Rock Island, shut off from a western outlet by the great barrier since their arrival in the eighties, may extend their operations to the Pacific Coast thru use of the tunnel, while, thru the same agency, the Western Pacific need no longer serve as a feeder line to the Union Pacific. The men who finally brought to successful conclusion the fight for a tunnel thru the Continental Divide ever had as their inspiration the vision of an open gateway, and made supreme, and in some cases fatal sacrifices to preserve this ideal.

The regrettable feature of the story told in the foregoing pages is that all Colorado citizens could not envision the ultimate purpose, nor realize its state importance. There were men in Denver who had amassed their fortunes from the soil of Colorado, who might have come to the rescue in times of stress, and their failure to do so caused many heart-burnings to Moffat and his associates. There were others who differed honestly in opinion as to the value of the tunnel, deeming it a threat to those sections of the state to which they owed first allegiance. Again, there was the ever-present element that opposed the tunnel because of personal or political bias.

The most inspiring features in development of the railroad and tunnel were the facts that, in spite of overwhelming handicaps, the Moffat Road was constructed, in the main, by local capital; that in the darkest hours this control was never relinquished; that the tunnel was built entirely by voluntary taxation incurred by thousands of humble property owners residing in the Tunnel District, who retained *en masse* a wonderful faith in the road and in their state. The latter circumstance lends a patriotic sentiment, an impressive dignity and a popular vision to the long struggle that makes the story among the most unique and stirring of any railroad in the history of American steam transportation. For this reason alone, if for no other, the Moffat Road cannot be classed as the selfish enterprise of a few. It is the contribution of many thousands, beginning in early territorial days when the concept was formed; continuing down thru the years until the homeowner of every description and degree added his bit toward the greater development and glory of his state. The story of the Moffat Tunnel in this, its epochal significance, is the story we have endeavored to convey, the epic of empire that we have stressed; not especially to record and glorify the devotion and sacrifice of a few individuals, but to point the steady and increasing purpose of a great commonwealth, inspired by example of the few. The physical accomplishment, monumental in character tho it be, is less inspirational to the young than the spirit behind that accomplishment.

Future generations on fields and farms across the ranges, countless millions who will be born to fulfill their destinies in the Colorado River Basin, only to pass away, perhaps, as did their predecessors, the olden people of another race, will draw faith from the great tradition of the Moffat Tunnel. The idealism that made it possible will not be lost, for traditions are the stepping stones upon which civilization has risen to its eminence. In fancy, we hear the spirit of David H. Moffat, buffeted in life, say:

"It's God's present to our nation,
Anybody might have found it but—His Whisper came to Me."

END OF VOLUME ONE.

Appendix A

BOARD OF MOFFAT TUNNEL COMMISSIONERS OF THE MOFFAT TUNNEL IMPROVEMENT DISTRICT

Statement of Cash Receipts
(As Classified on the Books of the Commission)

FROM MAY 12, 1922, TO JULY 7, 1927

RECEIPTS

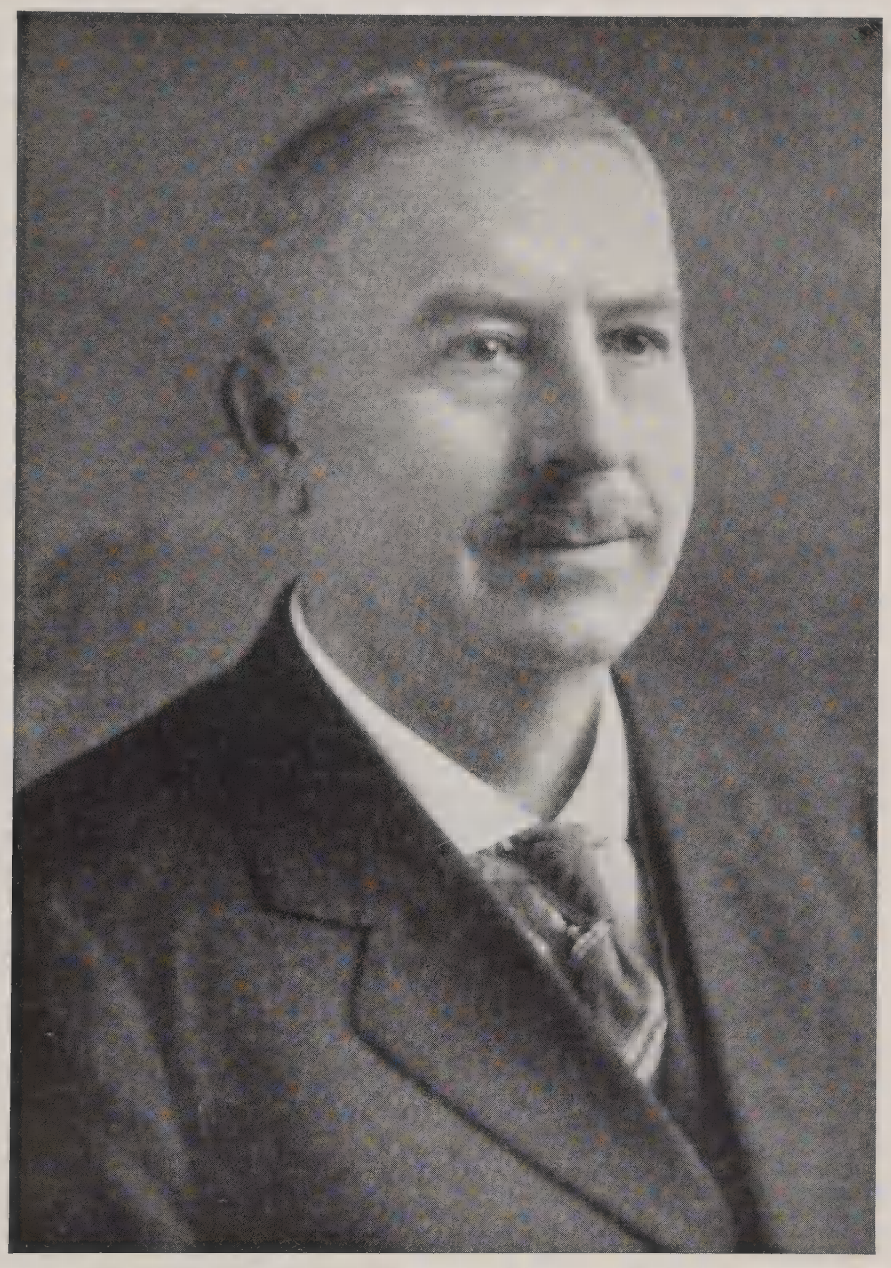
Sale of Moffat Tunnel Improvement District Bonds:		
First Issue, par value	$6,720,000.00	
First Issue, premium	214,999.95	$ 6,934,999.95
Supplemental Bonds 1925, par value		2,500,000.00
Supplemental Bonds 1926, par value		3,500,000.00
Supplemental Bonds 1927, par value	2,750,000.00	
Supplemental Bonds 1927, Discount	137,500.00	2,612,500.00
Accrued Interest on Bonds—First Issue		86,291.49
Accrued Interest on Supplemental Bonds 1925		28,947.90
Accrued Interest on Supplemental Bands 1926		70,291.50
Interest and Exchange, Net		402,081.73
Boarding House Receipts		1,031,798.76
Commissary Sales		464,378.26
Rent of Cottages		32,182.93
Hospital Receipts		73,315.91
Recreation Hall Receipts		229,532.51
Post Office Receipts		15,194.17
Power Line—Refund of Advanced for Construction		50,633.24
Miscellaneous Receipts		9,899.23
Total Receipts		$18,042,047.58

DISBURSEMENTS

	Moffat Tunnel Commission	Contractors Hitchcock and Tinkler, Inc.	
Bond Expenses	$ 33,492.35		$ 33,492.35
Legal Expenses	$ 114,965.20		114,965.20
Administrative Expenses	$ 158,359.48	$ 177,191.38	335,550.86
Engineering Expenses	$ 405,595.09		405,595.09
Administrative and Engineering Equipment	$ 19,176.77	$ 5,557.68	24,734.45
Camp:			
Buildings, sites, roads, etc.	$ 76,600.41	$ 225,111.84	
Equipment	8,366.58	31,716.14	
Maintenance	4,341.87	226,444.42	572,581.26

DISBURSEMENTS—Continued

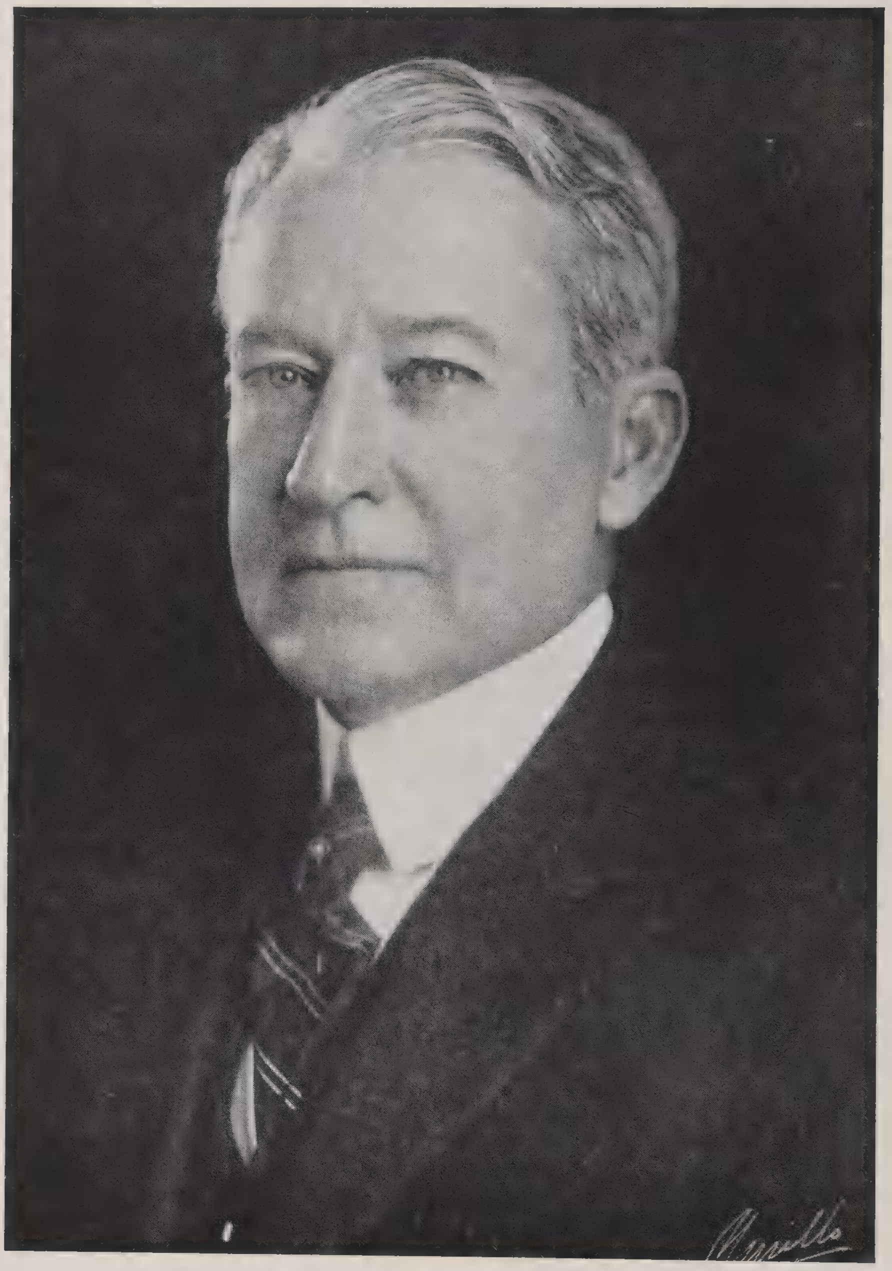
	Moffat Tunnel Commission	Contractors Hitchcock and Tinkler, Inc.	
Plant:			
Buildings	$ 115.51	$ 61,844.89	
Light, telephone lines, etc.		24,185.05	
Equipment		4,750.61	
Maintenance		52,416.30	
Machinery	7,135.94	632,650.99	
Tools	1,703.47	9,891.79	
Freight	7.78	62,295.80	
Hauling and erection		78,857.61	
Repairs	63.49	57,850.43	
Miscellaneous		892.02	994,661.68
Labor, Supplies and Expenses of Tunnel Construction	$ 370,538.06	$7,155,320.07	7,525,858.13
Stores, Less Issues Charged to Other Accounts		$ 174,136.35	174,136.35
Boarding Houses:			
Equipment		$ 9,345.44	
Supplies		518,260.86	
Expenses		218,767.03	746,373.33
Commissary:			
Equipment		$ 1,528.69	
Supplies		340,485.81	
Expenses		28,028.51	370,043.01
Hospital:			
Equipment		$ 7,149.67	
Supplies and Expenses	$ 67.13	65,311.65	72,528.45
Recreation Hall Supplies and Expenses		$ 180,932.25	180,932.25
Post Office Supplies and Expenses	$ 16.00	$ 17,635.34	17,651.34
Insurance	$ 58,791.54	$ 265,373.66	324,165.20
Contractor's Fee		$ 136,000.00	136,000.00
Advances for Construction:			
Power Line	$ 66,000.00		
Tunnel Ventilation	250,000.00		316,000.00
Funds:			
Bond coupon interest, including	7-1-27—		
First Issue	$1,466,025.00		
Supplemental Bond 1925	328,125.00		
Supplemental Bond 1926	275,625.00		
Supplemental Bond 1927	68,750.00		
Revolving fund and advances	225.00	$ 10,418.14	$2,149,168.14
Total disbursements			14,494,437.09



GOVERNOR OLIVER H. SHOUP, WHO SIGNED THE MOFFAT TUNNEL ACT

H. A. SUMNER, THE ENGINEER WHO LOCATED THE MOFFAT RAILROAD

A. C. RIDGWAY, WHO BUILT THE RAILROAD ACROSS ROLLINS PASS

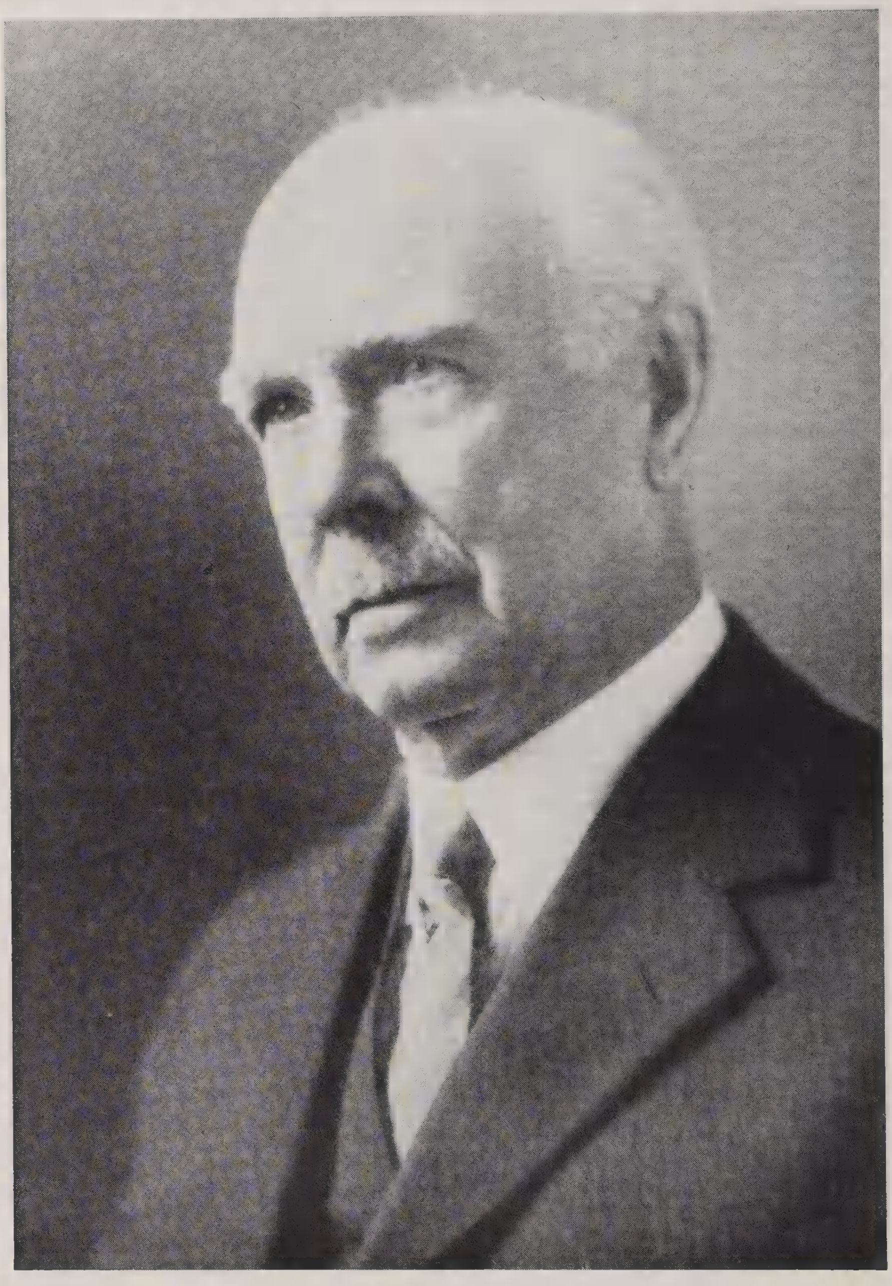


GOVERNOR HERBERT S. HADLEY, WHO DRAFTED THE TRI-TUNNEL BILL

EX-MAYOR D. C. BAILEY OF DENVER, HELPFUL IN THE TRI-TUNNEL CAMPAIGN

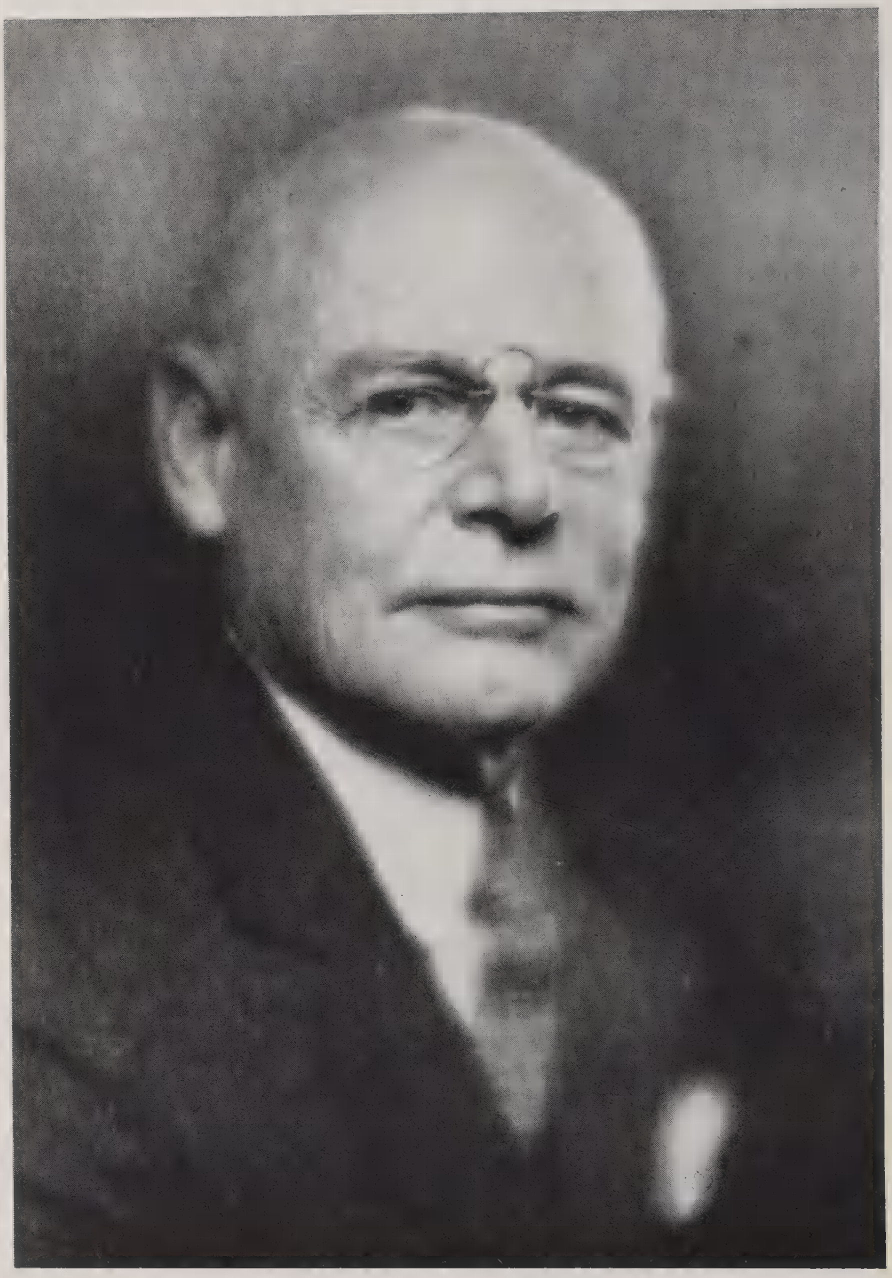
NORTON MONTGOMERY, GENERAL COUNSEL FOR THE TUNNEL COMMISSION

EKSKINE R. MYER, ATTORNEY FOR THE MOFFAT TUNNEL COMMISSION



D. W. BRUNTON, MEMBER OF THE BOARD OF CONSULTING ENGINEERS

J. VIPOND DAVIES, MEMBER OF THE BOARD OF CONSULTING ENGINEERS



J. WALDO SMITH, MEMBER OF THE BOARD OF CONSULTING ENGINEERS

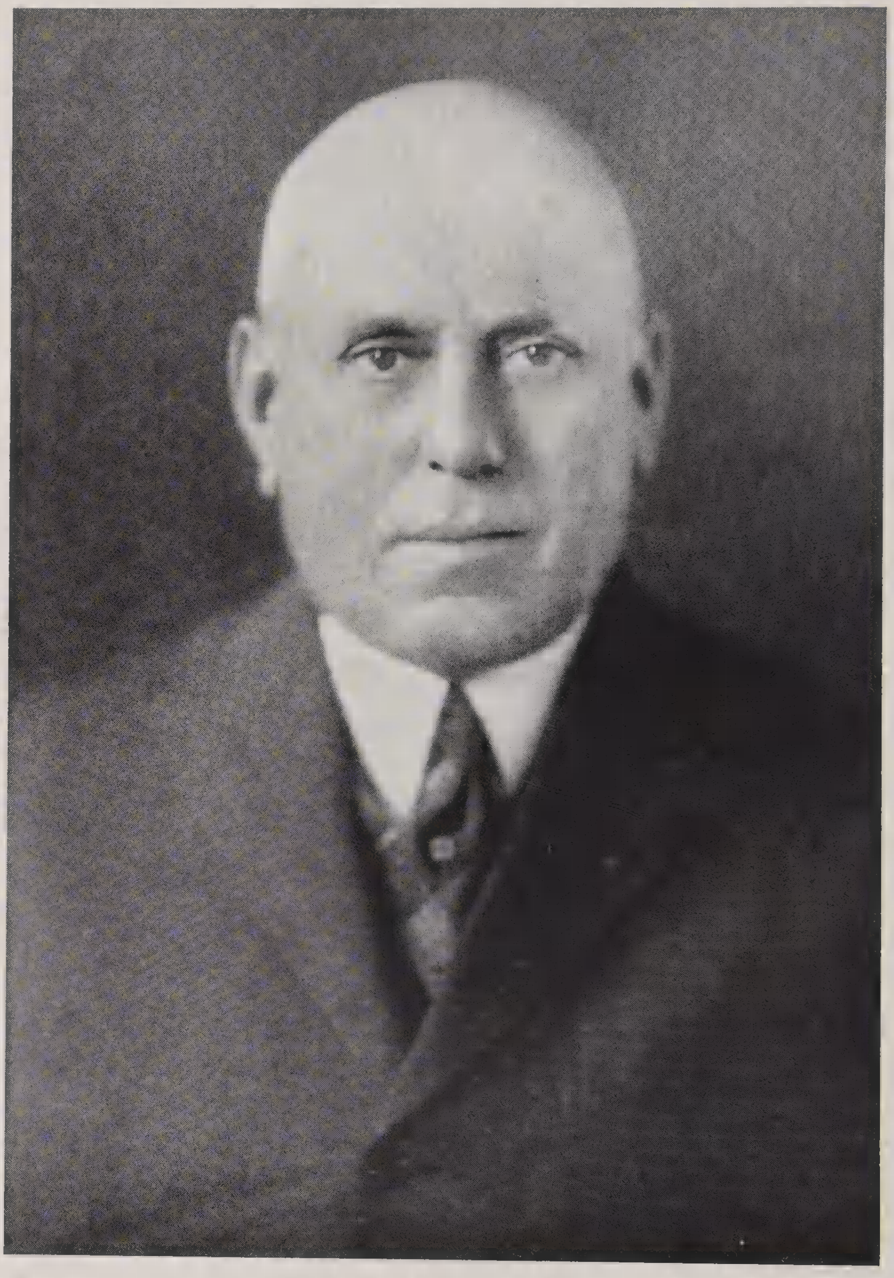
MAJOR L. D. BLAUVELT, MEMBER OF THE BOARD OF CONSULTING ENGINEERS

GENERAL MANAGER GEORGE LEWIS, INVENTOR OF THE LEWIS CANTILEVER BAR

I knew him

CLIFFORD A. BETTS, OFFICE ENGINEER OF THE MOFFAT TUNNEL

I knew him



F. C. HITCHCOCK, PRESIDENT OF HITCHCOCK & TINKLER, INC., TUNNEL CONTRACTORS

C. C. TINKLER, VICE-PRESIDENT AND GENERAL MANAGER OF HITCHCOCK & TINKLER

GOVERNOR W. H. ADAMS, WHO PARTICIPATED IN THE HOLING-THRU CEREMONIES